58

[*Extract from the Annual Report of the Department of Agriculture and Stock for the year 1938-1939.*]

QUEENSLAND

Department of Agriculture and Stock,
William Street, Brisbane

Report of the Director of Plant Industry (Research)

1939

Report of the Director of Plant Industry (Research).

The various activities of the Division of Plant Industry (Research) are reviewed in this report, covering the year under review, and which constitutes the second annual report of the Director of Plant Industry (Research). The Division was inaugurated early in the 1937-38 departmental year, but the annual report for that year did not constitute a review of a full year's activities of the new organisation.

The Division, as originally constituted, comprised Administrative, Agricultural, Botanical, Horticultural, Entomological, Plant Pathological, and Plant Physiology Sections. In the course of the year under review, however, the Bureau of Tropical Agriculture at South Johnstone was transferred to the Division of Plant Industry (Research), thus constituting an eighth section therein.

There has been an appreciable increase in the numerical strength of the Division, partly as a result of the transfer referred to and partly as a result of additional appointments to various sections. At 30th June, 1939, the staff consisted of forty-four officers engaged on investigational and field experimental work, one illustrator, one officer engaged on apiary work, and six clerical assistants, in addition to the labouring staff at the Bureau of Tropical Agriculture.

The year has witnessed further appreciable progress in implementing the programme of activities mapped out for the Division, these activities, as in the previous year, being carried out in close association with other appropriate branches of the Department, co-operation being naturally of most frequent occurrence with the Agriculture, Fruit, and Agricultural Chemistry Branches.

The Director of Plant Industry (Research) again deals with the Administrative Section of the Division, and also discusses some of the main features of the programmes allotted to the several sections. Each senior research officer in charge of a section has submitted a report dealing with the work of his staff, and these reports are attached hereto. These sectional reports do not contain full details of the work carried out during the 1938-39 departmental year, the procedure in this Division being to supply the details when the various projects are written up in the form of progress of final reports for publication in the *Queensland Agricultural Journal*. The sectional reports, however, supply a review of the activities of the Division which is adequate for the purposes of an annual report, especially when taken in conjunction with the extensive publication programme that is a feature of the activities of the Division.

The active control of the Bureau of Tropical Agriculture at South Johnstone has been assumed by Mr. J. L. Schofield, who commenced duty in November last. Mr. Schofield had considerable experience of the problems of tropical agriculture during a period of service in the Malay States prior to his present appointment.

Following an arrangement with the Council for Scientific and Industrial Research, it was decided that Mr. C. T. White, Government Botanist, should proceed overseas for an extended period as liaison officer at the Royal Botanic Gardens, Kew.

Staff Accommodation and Equipment.

The rapid growth of the staff at Nambour, consequent on the increased attention that is now being given to horticultural investigational work, necessitated the provision of additional accommodation, and this was obtained late in the departmental year, at comparatively little cost. The Nambour staff is therefore now adequately housed. Additional facilities were also provided at the Biloela Research Station, where an insectary was provided.

Nursery activities at the Bureau of Tropical Agriculture have been increasing appreciably, and it was considered desirable to provide irrigation facilities at South Johnstone so that the nursery stock would not be subjected to unduly severe checks during periods of low rainfall or absence thereof. An irrigation plant was accordingly acquired and despatched to South Johnstone at the end of the financial year. A lath house for plant propagation work was also erected at this centre, and a specially designed dryer was constructed in Brisbane and installed at South Johnstone to deal with the large number of grass samples which are handled in connection with the coastal pasture investigations of the Bureau.

Certain alterations were also made in the departmental building at Atherton, being designed to make more effective use of the floor space available in the building, and to adapt it for the requirements of a soil bacteriology laboratory rather than for an entomological laboratory, for which it was originally used.

Agricultural Investigations.

A perusal of the report of the Agricultural Section, submitted by the Director of Cotton Culture and Senior Research Officer, shows a considerable expansion in the amount of work handled by its staff.

Cotton plant-breeding work is discussed for the first time in the report of this section. It will also be observed that sorghum investigations are quite extensively discussed.

Certain of the activities of the Agricultural Section have again been carried out in the closest co-operation with officers acting under the supervision of the Director of Agriculture, this being particularly so in the case of the work on tobacco, cotton, sorghums, and potato. The report of the Director and Senior Research Officer will, therefore, refer in some considerable detail to the work done by this section in co-operation with the Agriculture Branch.

The report of the section indicates very definite progress in quite a number of directions, and it is particularly pleasing to be able to refer to the fact that 60 per cent. of the area sown in the last wheat crop was sown to varieties evolved by the plant-breeding staff of this Department. This is an excellent demonstration of the value of agricultural investigational

work, for it is only fair to assume that these varieties were extensively grown simply because they give better returns than are likely to be available from the varieties which they have displaced.

In the tobacco investigations the problem of yellow patch was very satisfactorily clarified, and there is now no reason why tobacco-growers in North Queensland should sustain losses through yellow patch in their seedbeds.

The plant-breeding activities in cotton, which have always been conducted on a very considerable scale, were still further intensified during the year, and it is pleasing to note that appreciable progress also is being achieved.

It will be noted that the pasture investigational programme is well under way, and is being pursued as actively as circumstances permit.

Botanical Investigations.

The Botanical Section again devoted a very considerable proportion of its time to the identification of specimens for departmental officers and for the general public, the staff also giving the necessary attention to the very extensive and valuable herbarium and museum.

Once again plants that are known to be, or are suspected of being, poisonous to stock involved the staff of the section in a considerable amount of work, and the various school project clubs were again given valuable assistance.

There has been no deviation from the previously accepted lines of work in this section, and its activities have proceeded normally and satisfactorily, and are reviewed in the attached report prepared by Mr. W. D. Francis, Botanist, who assumed control of the Section during the absence of Mr. C. T. White overseas.

Bureau of Tropical Agriculture Investigations.

The work at the Bureau has proceeded somewhat along the lines laid down in the initial stages of its development, and a very considerable amount of work on pastures, plant-breeding, and general horticulture has been undertaken by the staff. In addition to the work performed by these officers, certain activities, associated with the Bureau, have been carried out by officers not directly connected with its staff. The Instructor in Fruit Culture at Cairns, for example, has been responsible for the supervision of the comprehensive mango experimental programme which has been initiated at South Johnstone. Furthermore, the senior research officer in charge of the Horticultural Section of the Division, has been associated with the design and the conduct of the horticultural experiments at the Bureau. Here again is an instance of the steady development of the policy of the close association of several officers, connected with several branches in the Department, in the solution of a set of problems to which each of them brings something of value from his personal training and experience.

The Bureau officers, while interested very largely in coastal problems, are also associated with the work of other departmental officers located on the Atherton Tableland, and that association will probably become still closer as a result of the recent institution of the Tableland Experiments Committee.

Entomological Investigations.

There was some considerable reallocation of duties in the Entomological Section during the year under review.

It has been obvious for some time that an accession to the numerical strength of this section in Brisbane was rendered necessary, because of a decided increase in general entomological work and a concentration on the investigation of the important group of problems constituted by insects attacking market garden crops.

A research officer is now in charge of the entomological work at Toowoomba, which will serve as a centre for such work on the Downs and in the Maranoa, and he is now engaged on a survey of the problems occurring in that great stretch of territory.

General entomological investigational work has been carried on in North Queensland for a considerable number of years, and research officers are now engaged almost exclusively on a programme of general field investigational work, embracing such problems as pasture renovation, the production of crops for silage making, rotations, and other projects carried out under the general supervision of the White Grub Investigations Committee. Very satisfactory progress has been made with that programme of work.

Marked progress has been made in certain investigations during the year under review, and the position with respect to measures for the control of codling moth in the Stanthorpe district now appears to be reasonably satisfactory.

A new development in connection with banana weevil borer control was the introduction of a predatory enemy of that pest from the Federated Malay States, the actual importation being made by the Council for Scientific and Industrial Research.

The position with respect to bean fly control constitutes another example of progress in that a nicotine sulphate-white oil spray gives definitely satisfactory results, and another important pest has therefore been removed from the list of those which were previously regarded as being wellnigh uncontrollable.

The lantana leaf bug now appears to be firmly established at one centre on the Atherton Tableland, and the progress of this insect will be watched with interest during the next year or two.

The work on cotton and forestry pests continued more or less along the same lines as in the previous departmental year. The Queensland Cotton Board, which has co-operated in complete harmony with the Research Section of the Department, once more subsidised the appointment of the officer who is exclusively engaged on cotton pest investigations at the Biloela Research Station, and the Forestry Sub-Department was again responsible for the whole of the salary and the travelling expenses of the assistant research officer engaged on the investigation of pests of trees and timber.

Further information regarding the entomological work of the year will be found in the report of the activities of the Entomological Section.

General Horticultural Investigations.

The work of the Horticultural Section has proceeded along the lines laid down in the last two years and appreciable progress has been made in quite a number of the investigations. This is exemplified by the report on little leaf which was recently published in the *Queensland Agricultural Journal*.

Banana experimental work, which was just in the preliminary stages in so far as the Division of Plant Industry (Research) was concerned when last year's report was submitted, is now well under way and is being as actively pursued as circumstances permit, in association with the Banana Industry Protection Board.

It will be noted that work on the avocado and the mango is being actively engaged in, the former in South Queensland and the latter in North Queensland. The actual field work on both these fruits is being handled by officers of the Fruit Branch and is a further illustration of the close association existing between the Division and the Fruit Branch in the attack on horticultural problems in Queensland.

A perusal of the report submitted by the senior research officer in charge of the Horticultural Section, discloses no mention of work on pineapples, although an officer of the Horticultural Section is actually engaged, as a full-time officer, on pineapple plant selection studies. Most of the work on pineapples is conducted by officers in the Plant Physiology Section and the senior research officer of that section has accordingly reviewed the whole of the pineapple activities of the Division.

As in previous years, a subsidy was received from the Federal Government towards meeting the cost of the apple and pear investigational programme at present being conducted in the Stanthorpe district.

Plant Pathological Investigations.

A perusal of the report of the Plant Pathological Section indicates that considerable progress has been made in the investigation of a number of the more important diseases affecting economic plants in this State. It will be noted that the present programme of investigation of cereal diseases is approaching completion, and citrus disease investigations are similarly reaching a stage at which they will probably require considerably less attention in future than has been devoted to them in the past.

It is noteworthy that in several cases the results of well-designed and well-conducted experiments were inconclusive, as a result of conditions being unfavourable to the development of the diseases under investigation. In these cases it was impossible to obtain any reasonably clear contrast between the results of the treatments experimented with and the untreated control plots. This is a risk that must always be taken in carrying out plant pathological field experimental work, and there is no way of avoiding disappointments such as those just experienced.

During the year under review a subsidy was obtained from the Other Fruits Sectional Group Committee to ensure a greater degree of attention to the investigation of papaw disease, and the programme that has been made practicable by that subsidy is now in its preliminary stages. The same committee continued to subsidise the tomato disease investigations, and in this case a continuation of a subsidy by the Rural Credits Branch of the Commonwealth Bank was approved.

As in past years, the Forestry Sub-Department of the Department of Public Lands has been responsible for the salary and for the whole of the expenses of the assistant research officer who is engaged on the investigation of forestry pathological problems.

Plant Physiology Investigations.

The report of the Plant Physiology Section shows that the work therein has proceeded more or less along the lines laid down in previous years. The thirty-two demonstration plots continue to serve a very useful purpose by strikingly showing the advantages to be derived by the application of modern methods of pineapple production which have been found to be suitable under Queensland conditions.

An important new project was the initiation of comprehensive pineapple fertility trials in the Glasshouse Mountains district, and it is gratifying to be able to record that this ambitious set of trials got off to a very good start. It is also pleasing to note that the position with respect to the obscure malady of young pineapple plants known as crook-neck has now been clarified. The trouble has been demonstrated to be due to a zinc deficiency and appropriate corrective measures can now be taken for dealing with this problem.

A renewal of the water blister investigation was decided on during the year, for the very good reasons outlined in the attached report by the senior research officer in charge of the Plant Physiology Section.

The scope of work in the Plant Physiology Section has been appreciably expanded and investigations on papaw soil problems are now included in its programme of work. It was also practicable, during the 1938-39 departmental year, to give some attention to soil problems in the Tara district of the Darling Downs.

Once again appreciative reference must be made to the fact that the work of this section has been conducted in close and harmonious co-operation with appropriate officers of the Fruit Branch. Appreciation is also expressed of the valuable subsidies which have been received from the Pineapple Sectional Group Committee, the pineapple canners of Queensland, and the Fruit Industry Sugar Concessions Committee.

Soil Bacteriologist's Investigations.

During the year, a soil bacteriologist continued his work on the Atherton Tableland and in the Mareeba and Dimbulah tobacco-growing areas. On the Tableland, he worked largely in association with an assistant research officer, an instructor in agriculture, and a field assistant, and whose work constituted an integral part of the field investigational programme carried out under the auspices of the White Grub Investigations Committee. That programme of work has made very satisfactory progress and the sphere of the committee has now been enlarged. The soil bacteriologist was associated with the work on maize fertilizer experiments, the testing of maize and legume

mixtures for silage making and observations on the establishment of mixed pastures of grasses and legumes. He also devoted some time to the investigation of possible soil deficiencies in the Malanda and Peeramon districts. Yellow patch in tobacco seedbeds at Mareeba and Dimbulah occupied some of his time in association with officers of the Agriculture Branch.

Tableland Experiments Committee.

Some years ago, the White Grub Investigations Committee was established to act in an advisory capacity in connection with the field experimental programme designed to alleviate, if not solve, the serious deterioration of carrying capacity in certain dairying sections of the Atherton Tableland, which was associated with heavy infestation by white grubs. This committee consisted of three departmental representatives and three representatives of the primary producers. It functioned in a highly satisfactory manner and, during the 1938-39 departmental year, it was decided to extend the sphere of its activities to cover the whole of the general field experimental programme carried out by departmental officers on the Atherton Tableland. The personnel now consists of four departmental representatives and four representatives of primary producers and, in view of its extended sphere of activities, it has been redesignated the Tableland Experiments Committee.

Publications.

Regular contributions, prepared by officers of the Division, appeared in the *Queensland Agricultural Journal*, and included the following items:—

(1) Further Experiments on Mildew Prevention in Calico, with Special Reference to Tobacco Seedbed Covers, by T. McKnight.

(2) Queensland Weeds—Shrubby or Upright Mist Flower, by C. T. White.

(3) Brown Spot of the Emperor of Canton Mandarin and its Control, by L. F. Mandelson and F. W. Blackford.

(4) The Control of Banana Rust Thrips, by N. E. H. Caldwell.

(5) Codling Moth Control Experiments, 1937-38, by K. M. Ward.

(6) Cotton Jassids or Leafhoppers, by W. J. S. Sloan.

(7) Notes on the Genus Flindersia with Keys for the Determination of the Rain-forest Species, by W. D. Francis.

(8) The Acidification of Alkaline Nursery Soils for the Production of Exotic Pines, by H. E. Young.

(9) Pests of the Grape Vine, by J. Harold Smith.

(10) Grape Vine Diseases in Queensland, by R. B. Morwood.

(11) Some Notes on the Springsure and Clermont Districts, July, 1938, by S. L. Everist.

(12) Virus Diseases of the Strawberry, by F. W. Blackford.

(13) Field Notes on some Rain Forests and Rain Forest Trees of Tropical Queensland, by W. D. Francis.

(14) Little-leaf—A Functional Disorder of Apple Trees at Stanthorpe, by K. M. Ward.

(15) A Noxious Weed—The Needle Burr, by W. D. Francis.

(16) Wheatgrowing in Queensland, by R. E. Soutter.

A number of short articles, not included in the above list, also appeared in the *Weekly News Bulletin*, and were subsequently reprinted in the *Queensland Agricultural Journal*.

The preparation of Volume I. of *The Queensland Agricultural and Pastoral Handbook*, dealing with farm crops and pastures, is now well on the way to completion.

ROBERT VEITCH,
Director of Plant Industry (Research).

(1) REPORT OF THE AGRICULTURAL SECTION.

The operations conducted during the 1938-39 departmental year as part of the programme of investigations designed by the Agricultural Section of the Division of Plant Industry (Research) are reviewed in this report. Much of the work has been done by members of the staff of the Director of Agriculture and Senior Research Officer, and details of some of the experiments will be included by the respective officers in their reports to the Director of Agriculture.

Plant Breeding.

Wheat.—A comprehensive programme of wheat-breeding investigations was carried out by Mr. R. E. Soutter, Senior Research Officer.

The wheat-breeding investigations now deal largely with the value of various crosses made between rust resistant wheats and wheats that are satisfactory in most respects, except that they are not resistant to rust. Encouraging results were obtained by Mr. Soutter in 1937-38 in some of the hybrids studied, and, during the past season, definite progress was made in isolating strains resistant to conditions of severe rust infection. Much work remains to be done in such strains before a variety suitable for commercial distribution can be obtained, but it would appear that the present breeding programme may ultimately produce a satisfactory rust resistant variety.

As the wheat crop is grown during the driest portions of the year, and in districts experiencing less than a 30-inch rainfall, it is essential that a variety of wheat should have the ability to withstand prolonged dry conditions if it is to be of value for most of the Queensland wheat-growing districts. Particular attention has, therefore, been given to this very important point in the wheat-breeding programme conducted at the Roma State Farm during past years and gratifying success has been obtained. In the enlarged programme of investigations conducted this year, provision was made for continuing this important work at Roma.

Considerable concern has been expressed in some seasons by both millers and farmers regarding the occurrence of mottling, or yellow berry, in some varieties. These terms are applied to white and red wheat respectively, when the grain has a mottled appearance. Flour milled from mottled grain is not as suitable for making bread of good quality as flour obtained from a translucent sample of the same variety. There is now evidence that the occurrence of mottled grain is caused by seasonal conditions and/or environment, and may generally be attributed to a deficiency of nitrates. Some varieties appear to be more susceptible to mottling or yellow berry than others, however, and during this season work has been started with a view to testing the leading varieties grown in the State as to their tendency to this condition.

The general average quality of the wheat produced in this State is of a high order, and during the past season the surplus supplies of grain forwarded to Great Britain have received favourable commendation. With the expansion of wheat production in this State beyond the amount required for local consumption, it is desirable, however, that grain of still higher quality be produced. The gluten quality of a number of the most promising crossbreds and leading varieties has therefore been studied, with the assistance of the staff of the Agricultural Chemist, in order to provide information on this important factor.

The cutting of the glumes of the ears of wheat or other winter cereals, which is sometimes done in order to facilitate the crossing operations, often causes such an adverse reaction as to result in the production of very pinched grain. Where such grain is sown, the resultant plants are generally of poor constitution and frequently fail to develop. In an endeavour to ascertain whether such pinching of the grain is the direct effect of the mutilation of the flowers, or is also partly due to the reproductive organs being exposed to the extra light, an investigation was conducted in which cut flowers were covered with various coloured bags. The results obtained appeared to indicate that mutilation is the controlling factor. Whether atmospheric conditions exercised any influence or not could not be ascertained.

Several investigators are of opinion that the yielding capacity of a variety of wheat, or any other cultivated crop, the flowers of which are usually self-fertilized, becomes impaired with the successive growth of the variety over a series of years. It has been suggested that the yield capacity of such a variety can be restored by artificially pollinating flowers with mixed pollen collected from a large number of flowers of the same variety. A preliminary investigation of this claim was started in 1937, and it yielded sufficient information this season to warrant further tests on some of the leading Queensland varieties during the coming season.

The continued increase in the popularity of the varieties Flora, Puora, and Seafoam has necessitated the inauguration of a scheme of pure seed production that will provide ample supplies of pedigreed seed thereof. Accordingly a plan was evolved last season, in collaboration with the Wheat Board, which will ensure the production of sufficient seed of a satisfactory standard of each variety.

In view of the increased interest in wheat-growing in the Callide Valley and Theodore districts in recent seasons, it was considered advisable to enlarge the programme of wheat investigations that has been conducted for several years at the Biloela Research Station, in those districts. Accordingly, the degree of rust resistance displayed by a considerable number of the newer crossbreds evolved by Mr. Soutter was carefully studied by the manager of the station. The climatic conditions experienced were very favourable for the development of rust, and confirmation was obtained of the excellent rust resistance character of some of the strains that led in the tests conducted on the Darling Downs.

A comprehensive series of trials of the varieties that have shown promise over a series of

years at the Biloela Research Station was carried out by a senior instructor in agriculture. The objective in these trials was to test the merits of these wheats on the major soil types in the districts mentioned. Under the abnormal rainfall experienced, very good yields were obtained in all varieties, but the incidence of rust severely affected some of them. Considering the results as a whole, the variety Three Seas appeared to be the most suitable for the conditions experienced.

Barley.—The growers of barley in this State have experienced serious losses in some seasons through the effects of severe visitations of rust on both the yield and quality of the grain produced. Unfortunately no strains or cross-breds that have been evolved in the breeding programme have shown much promise of improving the situation. The work of barley improvement has hitherto been seriously handicapped through the lack of any variety that is resistant to rust under Queensland conditions. In the 1937-38 season, however, Pentland, a variety received through the courtesy of the New South Wales Department of Agriculture, showed conclusively that it was less susceptible to rust injury than any of the other strains or varieties grown in the tests. Crosses were accordingly made between Pentland and leading varieties of barley to obtain materials which may segregate superior rust resistant strains.

Field Pea.—Investigations have been conducted for several years into the possibility of developing a field pea for use in the drier districts, that would produce a pea which, when dried, would be suitable for culinary purposes. Crosses were originally made between Stratagem, a well-known culinary pea, and Paragon, a field type. The surviving selection of this cross was crossed in 1935 with the Telephone pea, a table variety. Groups of selections from this mating are being tested at the breeding centres located at Moggill, Kincora, and Bowen.

Cowpea.—The desirability of including a legume in the cropping system of the drier districts of the State led to the development of a breeding programme of improvement of the cowpea. Unfortunately, in the sandy soils of the drier areas, nematodes seriously attack most varieties of cowpea that might otherwise be grown satisfactorily. Accordingly, resistance to nematodes and abnormally dry conditions have been the major objectives aimed at in the breeding programme in the immediate past. The use of a cowpea as a green manure crop in the sugar-cane areas, however, where wilt-resistant varieties are required, has necessitated the formulation of an additional programme in which wilt resistance and also immunity from the attacks of the bean fly will be the major factors studied. Work was started in the 1937-38 season along these lines, the intention being to sow the first generation of seed at Roma and the second generation in the wilt-infected areas.

Oats.—Although a large acreage of several varieties of oats is sown each season for grazing purposes, most of the oaten chaff used in Queensland is imported from other States of the Commonwealth. The chief inhibiting factor for the production of oaten chaff of good quality in the districts where oats are grown for grazing purposes appears to be the incidence of rust. Accordingly, investigations were started to obtain data from a comprehensive range of varieties of oats, grown commercially in Australia, prior to initiating a cross-breeding programme in the coming season. Crosses will be made between the most suitable of these commercial varieties and rust-resistant varieties obtained from Canada and the United States of America.

Cotton.—Although rather variable climatic conditions were experienced in some of the cotton-growing districts, the general cotton improvement programme was completed fairly successfully. Selection work was carried out in eight varieties of cotton grown in sixteen breeding areas, with the co-operation of various officers of the Agriculture Branch.

An inspector in cotton culture, assisted in the work in the south, connected with the breeding areas of the Farm Relief, Oklahoma Triumph, and New Mexico Acala varieties and, in addition, supervised the growing of the seed multiplication plots of twenty-six new introductions. Some very promising selections were obtained in the three older varieties, especially in the New Mexico Acala, which gives promise of replacing the Indio Acala variety on account of the former having a better strength of fibre.

Work in the breeding areas of the Half and Half, Miller, and New Boykin varieties in the South Burnett district was conducted in spite of the adverse climatic conditions that occurred, and a considerable increase of seed was obtained in the most promising progenies of these varieties, which will enable enlarged areas to be planted in the coming season.

Excellent progress has been been made in the breeding areas of Lone Star and Oklahoma Triumph in the Central Burnett in past seasons in developing suitable strains of the Lone Star variety for the clay and clay loam soils of that district. One of the strains released this season for the multiplication of seed stocks produced approximately 1,600 lb. of seed cotton per acre under rainfall conditions. As the lint per centage of this strain is around 1½ per cent. absolute better than the parent stock it would appear that further definite improvement of this already suitable variety has been obtained. Very satisfactory progress in improving the Oklahoma Triumph variety for the fertile loams of that district has been made this season, and some of the leading strains will be increased preparatory to testing and releasing the best of them for general commercial growth.

Selection operations in the Miller and Half and Half varieties in the Upper Burnett District also were proceeded with. The lot 42 strain of the Miller variety is one of the promising selections made. It originated from a very hairy plant selected several seasons ago as possibly having some jassid resistance. Promising yields have been obtained in the subsequent increase plots of the strain, but considerable difficulty has been encountered hitherto in developing a satisfactory degree of uniformity of plant type. The progress made in this direction in the breeding area this season, however, has been so satisfactory that a comprehensive testing of the strains for jassid resistance will be carried out in the coming season.

Selection work in the Miller, Indio Acala, and New Boykin varieties was done in the Central District, and a superior strain of Miller, which is the most extensively-grown variety in this district, has been isolated, and will be increased as rapidly as possible to replace the bulk parent stocks. A large number of promising new selections were also obtained for testing in the breeding area in the coming season. The programme of improving the strength of the long-stapled Indio Acala variety that has been conducted for several seasons is bearing fruit, and several very promising strains of this variety were grown this season. These will be increased for further testing, and the best will be multiplied for general planting. Satisfactory progress also was made in developing improved strains of New Boykin, which is a variety that appears to provide good prospects of supplying a short staple cotton well suited for the alluvial soils of the Callide Valley.

The results obtained this season in the general cotton improvement programme have given every indication that superior strains will shortly be available of the varieties which are now grown to produce the types of cotton required by the Australian cotton spinning industry. Unfortunately, none of these varieties is entirely resistant to the jassid leaf-sucking insect which, under certain conditions, may seriously damage the cotton crops.

In the last two seasons, rather extensive losses resulted through jassid attacks, and it was accordingly decided to initiate a programme aiming at obtaining a jassid resistant variety. Unfortunately, the most widely-grown jassid resistant varieties of other countries produce cotton of a type not required in this country, and, in addition, have bolls that are too small for economical picking under Australian conditions. An assistant research officer, was, therefore, appointed to the Biloela Research Station, to carry out a programme of work consisting of isolating promising jassid-resistant plants in the varieties now grown here, and of investigating the possibilities of developing immune varieties through hybridizing the best of the local varieties with introduced jassid-resistant ones. Some very promising selections were located in some of the local varieties which were self-pollinated. The selfed seed will be planted in the coming season for further purification and testing in areas that generally experience jassid attacks. A comprehensive programme of hybridization studies was also conducted to ascertain the mode of inheritance of jassid resistance. Such work is of the long range research type, and, normally, will require several year's operations before any definite progress can be expected.

Peanut.

The programme of improvement of the Virginia Bunch variety of peanut was continued during the resent season. A yield trial of the most promising strains in the test carried out in the previous season was conducted. Strain number 77 led outstandingly in total yield of unshelled nuts per acre, but, unfortunately, produced significantly more smaller nuts than the next best strain.

Many peanut growers have experienced difficulty in obtaining a suitable stand through planting large A grade shelled kernels. The practice has, therefore, arisen of planting seed of C grade nuts, which contain a large percentage of small seed with a shrivelled skin, these appearing to produce satisfactory stands of plants. It is possible, however, that by repeatedly sowing the smaller shrivelled seed over a series of years, the general quality of the kernels produced will be adversely affected. Accordingly, an experiment to test the yield and quality of nuts produced from sowings of different types of kernels was started this season. The results obtained, indicated that medium-sized, normal kernels and large shrivelled kernels produced the best germination of plants. The plants germinating from A grade seed produced markedly fewer runners and also tended to experience less disease incidence than any other strain tested. There were no significant differences between the total yield of nuts or the percentage of any grade of nuts produced. Likewise, there was no significant difference between the weights of stover or plant residue after the nuts were removed. Unfortunately, the nuts had not been shelled at the time of writing, so no comment can be made on the size of kernels produced by each grade of seed.

Potato.

The growing of English potatoes is engaged in extensively in different districts of the south-eastern section of the State. Considerable diversity of opinion exists, however, regarding the most suitable cultural methods to adopt and the best varieties to grow in the different districts. In addition, the increasing use of irrigation plants to supplement the rainfall adds further complicating factors. Although very satisfactory yields are frequently obtained in most of the main potato-growing districts, a marked variation in production occurs that warrants investigations being conducted to ascertain the causes and possible remedies thereof. Preliminary to designing a programme of investigations into cultural practices, it was deemed advisable to conduct trials of the most extensively grown varieties to ascertain the best variety for each of the main subcoastal and coastal potato-growing districts. As two crops of potatoes are grown in a season in this section of the State, trials were planted in July and again in February in the Lowood and Mary Valley districts.

The results of the season's work in the two mentioned districts are somewhat indefinite. Apparently Manhattan is a reliable variety to use for either the July or February plantings in the subcoastal Lowood district. However, in two varietal trials conducted in this area in the later crop during the 1935-36 season, which experienced dry weather and heavy tuber waste, there was little difference between the Manhattan and Scottish Triumph varieties as regards yields of commercial potatoes, although there was a definite tendency for Scottish Triumph to produce a higher total yield. The Mary Valley results were inconclusive.

A trial of various fertilizers was also conducted to ascertain whether the application of a fertilizer would improve yields on the alluvial soils in the Lowood district. No statistically

significant differences in yields were obtained, but there was a definite tendency of the unfertilized areas to produce the highest yield of potatoes. There also was an indication that the addition of 1 cwt. of sulphate of ammonia to either 3 cwt. of superphosphate, or 3 cwt. of superphosphate and 1 cwt. of muriate of potash, tended to depress yields somewhat.

Tobacco.

As was pointed out in the 1937-38 report, there is always a lag of one season in presenting the results obtained from the tobacco investigations, due to the necessity of selling the leaf before the final data are obtained. This report, therefore, covers the work that was mostly conducted in the 1937-38 season.

Another comprehensive series of experiments and simple demonstrations was carried out by various members of the field staff of the Agriculture Branch.

Climatic conditions adversely affected the late section of the Mareeba-Dimbulah crop, as well as crops in all other districts except the south-west, and it was, therefore, difficult to obtain dependable data in some of the investigations. In several cases adverse climatic conditions, lack of sufficient co-operation, or other adverse factors necessitated abandoning certain field experiments. Definite progress was made, however, in solving some of the problems associated with the tobacco-growing industry in this State.

During the 1938 seedbed season, tobacco-growers were advised that the seedbed disease, known as "yellow patch," which has caused increasing concern during the past few seasons, could be avoided by using nitrate of soda as the sole source of nitrogen in seedbed fertilizers, instead of mixtures containing organic forms of nitrogen. This recommendation was based on investigations and observations on this disease made in North Queensland during the past few seasons. Seedbed demonstrations to illustrate the value of this recommendation were successfully established at both Dimbulah and Mareeba in August, and repeated two months later.

Further investigation of preparations to prolong the useful life of tobacco seedbed covers confirmed previously reported results that alum-lead acetate or Shirlan A.G. could be recommended for this purpose.

Rate of seed-sowing experiments indicated that a sturdier type of plant could be obtained by sowing seed at a lighter rate than is generally practised, and that about 1 oz. of seed to 2,000 square feet of seedbed appeared to be the most suitable rate of sowing. Seedlings from these experiments, which were conducted in the Miriam Vale district, were set out in field trials for further observation, but the severe drought conditions experienced did not permit statistically significant results being obtained. There was a suggestion, nevertheless, that higher yields and values could be obtained with plants from comparatively lightly sown seedbeds.

Seedbed experiments in the Mareeba district indicated that, while some degree of control over blue mould infection could be obtained with colloidal copper, a more effective control resulted from the use of benzol or a combination of benzol and colloidal copper. When seedlings from these experiments were further observed for disease incidence in the field at Mareeba and Bowen, there was a suggestion that less frog-eye occurred where seedlings had been sprayed with colloidal copper in the seedbed, or where plants were primed in the field. This question is also referred to in the report of the Plant Pathological Section.

At Bowen, Mackay and Dimbulah, confirmatory data was obtained that the American plough cultivation method was superior to the local procedure. At the last-named centre a preliminary investigation gave promising results with a 4 feet 6 inches spacing between the rows and 21 inches spacing between the plants in the rows.

Fertilizer experiments indicated that at Dimbulah the best results were obtained where 25 lb. of nitrogen, 80 lb. of phosphoric acid, and 30 lb. of potash were applied per acre. In the Mackay district, exploratory trials, notwithstanding very adverse conditions, suggested that yields might be enhanced by either applying the mixed fertilizer or the nitrogen and potash components in two applications. In the Miriam Vale district weather conditions were quite abnormal, but interesting information was obtained on the effect of nutrition on drought injury. Statistical investigations indicated that increased drought injury occurred with increasing quantities of nitrogen, and optimum quantities under the environmental conditions experienced consisted of 30 lb. of nitrogen and 70 lb. of phosphoric acid per acre. Field observations also suggested that drought injury was reduced where relatively large quantities of potash were applied.

The varieties Warne and Kelly gave the highest yields in an experiment at Dimbulah, but conditions were so adverse that reliable data could not be obtained for leaf value. In the Miriam Vale district, Virginia Bright Leaf, a new variety for Queensland, gave the highest yield of all the varieties. Because of drought conditions, differences in value were not investigated.

In rotation trials, natural weed growth gave the best results where it preceded tobacco after a crop of peanuts at Mareeba, or after tobacco at Gayndah. Peanuts were best preceding tobacco at Home Hill and second best at Gayndah.

In the Mackay district, simple exploratory experiments indicated that either rye or canary grass gave promising results as winter cereals to precede tobacco. In these experiments there was also a suggestion that the efficiency of the fertilizer for tobacco might be improved by the addition of magnesium.

Sorghums.

The yields of grain sorghum seed, obtained by farmers in recent years in trial plots of different varieties of both the kaffir and the milo types of sorghum, and in the varietal tests and comparisons of sorghum and maize conducted at the Biloela Research Station, indicated that in the agricultural districts experiencing less than 30 inches of rain, grain sorghums can be

expected to produce as well as and frequently better than maize on many of the soil types of these areas.

During the past season, a comprehensive programme was carried out in conjunction with the Director of Agriculture and Senior Research Officer, and several field officers of the Agricultural Branch, to test the merits of the Hegari, Kalo, Wheatland Milo, and Day Milo grain sorghums, in comparison with the leading variety of maize in the respective districts in which the experiments were located. The climatic conditions experienced as a whole were favourable for good growth of both the sorghums and the maize, and an interesting set of results will be obtained. All the experiments have not been harvested and threshed at the time of writing, but it would appear that the leading variety of sorghum in each experiment has generally out-yielded the companionate maize variety.

A representative number of other varieties of grain sorghums and sorgos, or saccharine sorghums, as they are frequently called, was also tested in several of the most important agricultural areas, preliminary to selecting a comprehensive range of sorgos and kafir and milo grain sorghums for inclusion in district varietal trials.

In addition to the varietal trials, pure seed-selfing plots were established in the Rockhampton, Kingaroy, and Roma districts to ensure ample supplies of seed for seed increase plots and varietal trials in the future.

Some 15 acres of sorghums were grown at the Biloela Research Station, which embraced pure seed areas, varietal tests of both grain sorghums and sorgos, and row spacing trials. Of the grain sorghums grown in Queensland for some years, the Kalo and the Wheatland Milo varieties led in yields of seed per acre. The Kalo variety, which has given the highest yields of grain at the station in most of the trials conducted over four seasons, was also tested against the most promising of several kafir and milo types introduced from the United States of America and grown at the station in the 1937-38 season. It was also tested against a comprehensive range of the varieties of grain sorghums that have been grown in this State for several years. The general results obtained indicated that, under the conditions experienced, the Kalo variety was superior to all but a few of the other varieties. Some of the leading newer varieties yielded very satisfactorily, and may prove to be of marked value for certain districts.

A varietal trial of six promising sorgos, introduced in the 1937-38 season, yielded excellent returns with the leading variety producing 25 tons of green fodder per acre. The merits of the best of these varieties will be tested in the coming season against the varieties of sorgos commonly grown in this State.

Seed of some fifty odd varieties of grain sorghums and sorgos was received during the season from the United States of America and was grown at the Biloela Research Station for pure seed multiplication. Altogether a total of ninety-five varieties of sorghums were studied at that centre, and pure seed of these was obtained for conducting tests in other areas in future seasons.

Trials were also conducted with the Kalo variety at the station and in the Kingaroy district, to provide evidence as to the relative merits of various row spacings, ranging from a 7-inch interval up to 49 inches. Some reduction in the size of the heads occurred in the closer row spacings, even under the good growing conditions experienced, but better total yields of grain per acre were obtained in these row spacings in both experiments. In a row-spacing test, conducted at the station during the 1937-38 season, under very dry conditions, the results rather indicated that row widths of less than 3 feet might not be satisfactory in dry areas.

The general results obtained in the experimental programme, and also in commercial plantings during the season, have provided evidence of the advisability of growing sorghums on an extensive scale both for grain and fodder production in most of the districts receiving less than 30 inches of rain in the south-eastern and central sections of the State.

Pastures.

A comprehensive long-term programme of investigations dealing with the most important pasture problems of the State was drawn up during the 1938-39 departmental year and received approval. Certain of these investigations were selected for immediate initiation, but it was not possible, for various reasons, to start all the desired projects.

Pasture renovation and legume adaptation experiments were initiated at Dayboro and Cooroy. Following on a survey dealing with the rehabilitation of pastures in the Dayboro district, mentioned in last year's report, an experiment was started in that area to investigate the merits of various methods for restoring the original pastures of paspalum, and also for increasing the carrying capacity of the existing blue couch grass pastures that have replaced the paspalum. In connection with the latter, it was noted that the total exclusion of stock from blue couch grass paddocks throughout the whole of the growing season resulted in no appreciable increase in the bulk of grass produced. The same result was observed in parts of the Kilcoy district, to which the blue couch grass survey was extended during the year.

A paspalum pasture renovation experiment, designed mainly to determine the frequency with which paspalum pastures on the yellow clay soils of the Cooroy district require to be renovated, was commenced at West Cooroy. Various incidental aspects of pasture renovation also are being studied. Results from trials dealing with the incorporation of white clover in paspalum pasture suggest that, if mid-summer renovation is practised, it is advisable to sow clover seed immediately following renovation rather than to delay sowing until the grass has recovered from the ploughing.

The top-dressing of paspalum pastures in the Southern Coastal districts with superphosphate does not always result in a beneficial response being obtained. Accordingly, the testing of various methods of placement of superphosphate in paspalum pasture was commenced, and in

connection with this work phosphate fixation in these pasture soils is being investigated.

As part of the pasture improvement programme of the Southern Coastal districts, it is desired to incorporate legumes in the pastures, and preliminary to this work an investigation of the suitability of a wide range of legumes was commenced at Cooroy and Dayboro.

Investigations in the experimental plots established in the Blackall district three years ago were continued. The results obtained to date indicate that the soil type appreciably influences the rate of regeneration of the vegetative cover under the different treatments being studied. In some instances, a very slow increase in suitable grasses has resulted from resting an area, while, on other soils, no improvement can be noted over the adjacent grazed areas.

A survey was made of the Springsure, Emerald, and Clermont districts, as well as of the regeneration of a drought-stricken area near Arillabah, following early summer rains, and much useful information was obtained that will assist in forming a background for planning more intensive operations.

An extensive botanical survey was also made in the Tara district, in the area reclaimed from prickly-pear, in the course of an investigation with an animal nutrition research officer, and an assistant research officer, into the possibilities of this district for sheep-raising.

An important investigation in the pasture improvement programme is the study of the value of various methods of trapping moisture in pastures. Experiments along these lines were started at Dayboro' and the Biloela Research Station, and arrangements were also completed for initiating two such experiments in the Blackall district during the early part of the coming season. Although the distribution of the rainfall at the station was such as to favour good growth of the grass, the areas that were furrowed with a single mould-board plough at 4 feet and also at 20 feet intervals maintained a higher percentage of superior species throughout the season than did the control areas. A reduction in the production of grass resulted at first in the areas with the more closely-spaced furrows, due to a greater area of the sod being disturbed, but, during the latter part of the season, a greater production of grass, which was of a higher quality, was obtained in this treatment than in any other.

In investigations conducted at the Roma Demonstration Area and at the Biloela Research Station, it has been observed in several seasons that the older broadcast areas of introduced grasses reacted more severely to adverse conditions than new plantings of these same grasses. Experiments were accordingly started to test the merits of sowing a grass in wide broadcast areas as compared with 3 feet strips of grass alternated with 3 feet cultivated strips of bare soil, using Rhodes grass (*Chloris gayana*) and Blue Panic (*Panicum antidotale*) at the former centre, and Rhodes grass in 5-foot strips alternated with 4-foot cultivated areas at the Research Station.

The adverse conditions experienced at Roma resulted in such poor stands in the experiments designed for that centre that they will have to be replanted. A satisfactory stand was obtained in the experiment at the Biloela Research Station, however, and it yielded interesting information for the rest of the season. Nitrate determinations conducted in it on a monthly basis indicated that the grass in both the broadcast and strip areas significantly reduced the nitrate content of the upper 6 inches of soil at the same rate. There was also some tendency for the grass in the alternated strip areas to reduce the nitrate content of the interspaced cultivated strips as compared with the fallowed controls. It is anticipated, however, that by frequent cultivation of the interspaced areas, the soil will be aerated sufficiently to allow of the replenishment of the supplies of nitrates being effected, and thus stimulate a greater growth of grass of higher quality in the strips than will be produced in the accompanying unrenovated broadcast areas.

During the year, preliminary studies of Curly Mitchell (*Astrebla lappacea*) in relation to the storrage of food supplies were made. The results obtained indicate that this grass stores large quantities of starches in the culms, rhizomes, and roots. These are utilized by the growing shoots, the starches in the culms being apparently used by the culm shoots, while the starches in the rhizomes and roots are used for the development of the innovation shoots. Further work is required to elucidate the period in the life of the plant at which the reserves of starches are stored and for what period after the new growth commences the plant draws on these reserves. Possessing such knowledge, it should be possible to obtain a sound understanding of the effects of different methods of pasture management on the Mitchell grasses.

Three cases of suspected plant poisoning of sheep were investigated, and in one a hitherto unsuspected poisonous plant was discovered. Feeding tests of this plant, *Threlkeldia proceriflora*, which is known as the Soda Bush, were conducted at the Animal Health Station at Yeerongpilly, and proved it to be poisonous. The cause of many mortalities of sheep in the Longreach district has been traced to this plant.

An area of land at the demonstration area at Moggill, near Brisbane, was made available during the year for plant introduction purposes. The material planted comprised twenty strains of lucerne, thirty clovers and medics, thirty grasses, seven lespedezas, and six vetches. A number of lots of seed was supplied by the Council for Scientific and Industrial Research.

Biometrics.

The volume of investigations conducted during the past twelve months by the officers of the Department of Agriculture and Stock was appreciably greater than that of the previous year. This increase in investigational work created a continuous demand for biometrical aid, both for advice in planning experiments, so that the results obtained would admit of statistical treatment, and in the subsequent analyses of the data collected.

The experiments ranged from a few simple comparisons by the half-drill strip method, and through a large number of randomized blocks

and latin squares, to the more complicated factorial designs, and included investigations into a wide variety of problems relating to agronomy, agrostology, entomology, horticulture, plant pathology, plant breeding, and plant physiology. Altogether, some seventy experiments were analyzed during the year.

The results obtained thoroughly indicated the value of using the most modern technique of experimentation and methods of analyses of the data collected from properly designed experiments. The use of such technique has made it possible to obtain comprehensive information with a minimum expenditure of time and money.

General and Acknowledgements.

The officers of the Agricultural Section of the Division of Plant Industry (Research), in addition to conducting a heavy programme of investigational work, have engaged in considerable general advisory activities. A series of illustrated talks to farmers was given in connection with the propaganda campaign, sponsored by the Queensland Cotton Board, to increase the acreage of cotton during the coming season.

The valuable co-operation given by the Director of Agriculture and Senior Research Officer, and the fact that various members of the Agriculture Branch staff carried out the actual work connected with a number of the experiments reported upon, is greatly appreciated and gladly acknowledged. Likewise the Agricultural Chemist and several members of his staff have rendered valuable assistance in regard to making various analyses, without which several of the investigations could not have been conducted.

W. G. WELLS,

Director of Cotton Culture and Senior Research Officer (Agricultural Section).

(2) REPORT OF THE BOTANICAL SECTION.

During the past year the Botanical Section has been occupied primarily in identifying and reporting upon native and cultivated plants and plant products, and in maintaining and augmenting the collections of the herbarium and museum. The Government Botanist, Mr. C. T. White, left Australia in January to take up his appointment as Australian Liaison Officer at the Royal Botanic Gardens at Kew in England. Here he will devote a large proportion of his time to working on Queensland material or on material of interest to Queensland. The work of the section has proceeded along previously accepted lines, and some of the more important features of its activities are discussed in the following paragraphs:—

Poison Plants and Suspected Poison Plants.

When outbreaks of sickness occur in stock, it is frequently assumed that the vegetation upon which the animals have fed is to blame, and it is natural that information regarding the character of the vegetation should be sought. Consequently, the Botanical Section, during the year under review, received a large number of specimens of plants suspected of being poisonous or harmful to stock. These specimens were sent in by the Poison Plants Committee of the Department, the Animal Health Stations at Yeerongpilly and Oonoonba, veterinary surgeons, stock and dairy inspectors, pastoralists, farmers, and others. In most cases, specimens of plants received by the Poison Plants Committee for experimental feeding tests, and by the Agricultural Chemist for analysis are submitted to the Botanical Section for verification of the botanical name. Records are then compiled in this section under the name of each species showing the general habit of the plant, the kinds of animals poisoned or suspected of being poisoned by it, the evidence of toxicity, any references to published papers dealing with the species and its association with poisoning or suspected poisoning, the geographical distribution of the plant, the districts from which supplies of the plant are obtainable, and other particulars. A considerable volume of information on these plants is accordingly being steadily accumulated. Furthermore, in most instances in which specimens are sent direct to the Botanical Section as being suspected of causing poisoning or being harmful, copies of the reports thereon, prepared by the section, are referred to the Poison Plants Committee, and in this way the committee is further informed of the complaints of pastoralists, drovers, farmers, and others, concerning vegetation. Thus fresh cases for investigation and possible sources of supply of suspected plants are introduced to the committee. The activities of the committee have produced important results which enable the Department to give precise information regarding the properties of several plants occurring in Queensland pastures.

Weed Taint in Meat.

One rather unusual instance of the effects of pasture plants on food came under notice during the year, the Department's attention being drawn to the occurrence of a peculiar turnip-like taint which occurred occasionally in meat in a certain country town. From the description of the taint and the prevalence of certain weeds at the time of its incidence, it was considered that it might be due to the stock feeding on cruciferous plants, and perhaps more particularly on wild mustard, *Lepidium ruderale*. As anticipated, the taint disappeared with the advent of the warmer summer weather, when weeds of the crucifer family become much less prevalent. It is possible that the taint may recur in the late winter of the present season.

Native Plants in Human Diet.

In the course of the year the section was associated with discussions by the Queensland Nutrition Council relative to the possibilities of native plants being used as human food. As a result of these discussions the Department of Health and Home Affairs and this Department are co-operating in a scheme to publish illustrations, descriptions, and directions for the use of edible plants which occur in different parts of the State. In this way, it is hoped to bring under public notice those plants which can be safely recommended as an advantageous supplement to the ordinary diet of people in different parts of Queensland.

Food Plants of the Aborigines.

In the past few months, specimens of fruits and bulbs of native plants which provide sustenance for the aborigines have been identified by the section. These specimens were submitted by the Department of Health and Home Affairs, which received them as a result of a survey of such matters in North Queensland. It is understood that the specimens, after being reported upon botanically, are to be investigated and reported upon by the Government Analyst.

School Project Clubs.

A very large number of specimens of grasses, weeds, shrubs, and trees were received from secretaries of school project clubs, and these were identified and reported on. In all cases where they were applicable, notes were supplied as to the economic value of the plants from which the specimens were derived. This service should be helpful in encouraging pupils to observe the vegetation in the vicinity of their schools and their homes, and in assisting them to assess its economic importance.

Forest Botany.

As in previous years, a considerable proportion of the time of the staff of the section has been spent on botanical work in connection with the forests of the State, and a large number of specimens were identified on behalf of the Forestry Sub-Department of the Department of Public Lands.

The Commonwealth Forestry School conducted a forestry camp at Turallin, in the Milmerran

district of the State, in May, 1939, and in the course of investigations carried out at the camp some hundreds of botanical specimens of trees, shrubs, and herbs were collected. These specimens were sent to this section for identification and most of them have now been identified, although a few have been held over for closer examination.

In the course of the year, a paper comprising field notes on sixty-four species of trees of the tropical rain-forests, and notes on the rain forests of the State, was prepared for publication and issued in the *Queensland Agricultural Journal*.

Undescribed and Unrecorded Plants.

In the course of field and herbarium work, further undescribed species and plants not previously recorded for the State are met with. Nineteen such new species were recently described and the descriptions published in "Contributions to the Queensland Flora," No. 6, which appeared in the 1939 volume of the "Procedings of the Royal Society of Queensland."

Field Work.

The Government Botanist, Mr. C. T. White, spent a week on field work on the Eungella Range, west of Mackay, in August, 1938. A large number of botanical specimens were collected and some of these were incorporated in the herbarium, while others were used for exchanges with kindred institutions in other parts of the world.

As a result of a visit to Kindon Station in the Goondiwindi district in December, a comprehensive report was submitted on the Kindon pastures and vegetation generally.

Acknowledgments.

During the year, Mr. S. T. Blake, Walter and Eliza Hall Fellow in Economic Botany, has frequently utilised the section's herbarium and library, and the section is indebted to him for the determination of many sedges, a group of plants of which he has made a special study.

W. D. FRANCIS,
Botanist.

(3) REPORT OF THE BUREAU OF TROPICAL AGRICULTURE.

The second half of the 1938-39 departmental year was devoted by the Director of Tropical Agriculture to a survey of the agricultural possibilities of North Queensland from the economic aspect. Such a survey was essential as soon as he assumed control of the Bureau of Tropical Agriculture, and it was accordingly commenced a few weeks after he arrived in Queensland.

The work of the Bureau must of necessity be directed towards achieving a flexible and stable form of agriculture, in addition to the production of sugar-cane, which will lead to closer settlement of the tropical coastal region. In formulating a research programme with such an objective, stress must be placed on the necessity for intensive, rather than extensive, methods of agriculture, in order to meet the requirements of closer settlement, and to ensure, as far as is practicable, satisfactory remuneration to the settler. The research programme has been designed accordingly.

Pasture Development and Improvement.

An early and satisfactory conversion of biotically induced grassland, and natural grassland, to improved pasture, is a matter of definite importance to the farming community on the coastal belt of North Queensland. Research on the many problems which arise in this connection is necessary, and plans are now under consideration for a series of experiments, on selected farms and at the Bureau of Tropical Agriculture, to investigate thoroughly the economic possibilities of such a development. Experiments with numerous grasses are in progress, and during the coming year it is proposed to carry out trials with various pasture mixtures of the most promising grasses and legumes. The first stage of pasture improvement, increased fertility and organic matter accumulation, will be associated with the introduction into the sward of a suitable legume.

At the Bureau, extensive trials are being carried out with legumes, particularly fodder legumes, to discover suitable types for pasture work. In this connection it is satisfactory to report that Brazilian lucerne, *Stylosanthes guyannensis*, which is already established at South Johnstone, is yielding promising results. This legume is aggressive, drought resistant, and capable of withstanding successfully heavy and continuous rain. Palatability trials with freshly cut samples from the Bureau have been carried out at the Animal Health Station, Oonoonba, and the results indicate that this legume is readily eaten by stock. It is now being incorporated in mixtures with various grasses to obtain data in respect to its value as a pasture component. Promising results have been obtained with several other legumes, and a palatability trial with each has been concluded.

Important information has been obtained from the experiments conducted on paddocks at Tully, and the results of this work, from the animal husbandry point of view, have been summarised in a paper, "Cattle Fattening on the Coastal Wet Belt of North Queensland," by Professor H. R. Seddon and C. R. Mulhearn, which was read at the recent meeting of the Australian and New Zealand Association for the Advancement of Science.

Lucerne Experiments.

Another phase of legume experimentation at the Bureau, is a thorough investigation into the possibilities of economic lucerne cultivation. Two comprehensive experiments are being carried out, one with Hunter River lucerne and the other with Brazilian lucerne. The experiments include the application of four levels of lime and five levels of superphosphate, alone and in combination. A series of analyses will be made in conjunction with these experiments to determine the limits of nutrient content fluctuation with growth and fertilizer application. Concurrently, trials are in hand with eighteen different types of lucerne obtained from the Council for Scientific and Industrial Research.

Fodder Trials.

Plots containing the following fodders have been planted:—*Echinochloa frumentacea* or Japanese barnyard millet, *Echinochloa crus-galli* or common barnyard grass, and *Sorghum Roxburghii* var. hians. Investigation into the economic production of various fodders is a matter of considerable importance, following increased interest in animal husbandry.

Horticultural Investigations.

Special attention is being devoted to the asexual propagation of the mango at the Bureau by an officer of the Fruit Branch, who is associated with all the mango experimental work in North Queensland; various methods of budding are under trial to determine which is the most satisfactory for commercial practice. Investigational work is also being carried out on passion fruit, granadilla, and papaw; and the preparation of seedling material for a citrus root stock trial has been undertaken.

Agricultural Research on the Atherton Tableland.

Close contact has been maintained with the development of research work on the Atherton Tableland.

Considerable evidence has been obtained relative to the fertilizer requirements of maize grown in different areas. The development of silage on the Tableland has been rapid, and

experiments with various legumes for silage purposes have been carried out by the departmental officers stationed there.

The tobacco-growing areas of Mareeba and Dimbulah have been visited, in order to keep in touch with the progress of experimental work on this important crop.

Plant-Breeding.

Genetical work has been carried out on maize, tobacco, and papaw. With maize, the objective is to obtain a strain of seed which will produce a really satisfactory crop under the conditions prevailing on the Atherton Tableland. Various tobacco crosses have been made at the Bureau, which have been tested in the tobacco-growing areas of Mareeba and Dimbulah. The breeding work with the papaw is concerned with the production of varieties which will comprise only bearing trees, and a study of the inheritance of sex expression and sex vigour relations.

Analytical Work.

Analytical work connected with the cattle fattening experimental programme was continued. In addition, a number of soil samples from various localities have been analysed to determine their value for pasture development.

Acknowledgments.

The assistance given by the Council for Scientific and Industrial Research, in supplying seed of various legumes for trial at the Bureau is appreciated. The co-operation of the Acting Director of the Animal Health Station, Oonoonba, in the pasture experiments at Tully, and in arranging for palatability trials with various legumes from this Bureau, is gratefully acknowledged.

J. LEEMING SCHOFIELD,
Director of Tropical Agriculture.

(4) REPORT OF THE ENTOMOLOGICAL SECTION.

The year 1938-39 has been a relatively good one, with few crop failures due to pests or other causes. Nevertheless, the incidence of certain insects possessing economic importance was most unusual. Some minor pests proved destructive in certain localities, and a few which normally cause appreciable losses every year were less troublesome than usual. The phenomenon must be ascribed to climatic conditions, heavy winter and spring rains having preceded the normal wet season, which was broken by hot dry weather in January. The effect of these conditions on either the insects themselves or on their associated parasites could create such an inversion in the pest position.

Deciduous Fruit Pests.

The codling moth, *Cydia pomonella* L., was very destructive in the apple crop at Stanthorpe and the amount of fruit rejected because of that pest was therefore considerable. The control programme was complicated by unsettled weather, which made strict adherence to any spray schedule almost impossible.

In the codling moth experimental programme, the following cover sprays were compared: lead arsenate, white oil, and a number of combined sprays containing white oil and nicotine sulphate in varying proportions. Of the several sprays tested, that consisting of white oil 1½ gallons, nicotine sulphate 1 pint, and water 80 gallons, gave significally better results than the others. The most effective spray schedule, therefore, requires the use of lead arsenate as a calyx spray, the necessity of which was established last year, and cover spray applications with the foregoing combined spray.

In the same experiment, statistical data were obtained on the relative merits of timing cover sprays (*a*) at three-week intervals, (*b*) at five-week intervals, and (*c*) as indicated by moth records in suitably placed lure traps. Spraying at five-week intervals proved inadequate, but the other timed schedules gave quite good results. The lure trap method of timing sprays can therefore be considered as efficient as any alternative, and it has an advantage in that with it the number of spray applications is kept down to a minimum.

Having established the relative efficiency of possible codling moth sprays, and estimated the merits of spray timing methods, it is now practicable to issue more precise recommendations to the grower than has hitherto been possible.

The Queensland fruit fly, *Chaetodacus tryoni* Frogg, after being more or less quiescent in deciduous fruit areas for some years, increased in numbers in early spring and summer. Further experiments have been initiated at scattered centres to study the vexed question as to whether or no fruit flies do over-winter in the Stanthorpe district. The capricious behaviour of the presumed spring migrants suggests that, in some seasons, in a few locations, survival may be possible in spite of very strong evidence to the contrary in the district as a whole.

Following laboratory trials at Stanthorpe in 1937-38, field tests with three bait sprays in which tartar emetic, sodium fluosilicate, and lead arsenate were respectively the toxic ingredients, were initiated on plum trees. Twelve Stanthorpe orchards were under test, these being regarded as three groups of four orchards; three orchards in each group were treated with one or other of the bait sprays, the fourth orchard in each case being left untreated as a control. Losses, estimated in case lots, demonstrated that all three bait sprays in each group of four orchards effected considerable improvement over the control orchard.

Lure potentialities in fruit fly control are again the subject of investigation. The work was re-commenced in autumn at Nambour, and so far approximately forty lures have been tested.

Strawberry Pests.

A survey of strawberry pests conducted in winter and spring indicated that pathological and physiological disorders were of considerable importance in the strawberry crop, and it would appear that these disorders, in past years, have frequently been erroneously attributed by growers to the incidence of various pests. Actually neither thrips nor red spider—the two commoner pests—were at all common, and conditions have not permitted conclusive insecticidal experiments. Laboratory and insectary studies have, however, demonstrated beyond doubt that one species of thrips, *Neophysopus fragariae* Gir., is the cause of "russetting" on the fruit, a common and frequently serious defect. The damage follows injury at a very early stage in the development of the fruit. Now that this point is clear, control should be simplified, because "russetting" is a much better guide to thrips populations than any other symptom, and control measures can be guided by observable criteria.

Spray and dust trials are in abeyance pending the availability of suitably infested experimental material, but some observations are in progress as to the effect of treating runners with hot water or nicotine sulphate before planting on the later growth and on pest infestation. These trials should determine the applicability of overseas strawberry pest control practice to Queensland conditions.

Red spider, *Tetranychus telarius* L., has for long been reputed to show varietal preferences in Queensland strawberries, but these preferences are not well delineated. This is probably due to the fact that strawberry varietal names at present mean very little; alleged varieties include plants with quite distinct habits. Until some clarity is introduced into strawberry nomenclature, the significance of varietal preferences by red spider, if any, can scarcely be determined.

Banana Pests.

Since the present recommendations for the control of the banana thrips, *Scirtothrips signipennis* Bagn., were first published in 1937, some plantations have warranted treatment both north and south of Brisbane, and the number of such plantations has definitely increased during the year under review. The recommendations continue to be effective, but the costs of treatment are relatively high and may hamper the general adoption of the recommendations in an emergency. Substitute materials for the 11 oz. hessian bags have therefore been investigated. Various kinds of paper bags impregnated with preservatives of one kind or another, failed to withstand the torrential rain and strong winds during the summer months. Tubes composed of 11 oz. hessian proved useful, however, and can be procured either in bunch lengths or in rolls to be cut as required on the plantation. Costs are less and the tubes can, by tying the ends, be made to function as bags in current recommendations. The saving thus effected should tend to popularise control measures.

To assist in the control of the banana weevil borer a large colony of a Hydrophilid, *Dactylosternum hydrophiloides* McL., was obtained by the Council for Scientific and Industrial Research from the Federated Malay States on behalf of this Department. The larval stage of the Hydrophilid is predatory on the larvae of the pest. After being kept under observation in quarantine for three weeks, the insects were released at Tallebudgera, a compact banana-growing area. Later observations show that, although the numbers are now small, one generation has been completed, and there seems no reason why the insect should not ultimately become established in Queensland.

The investigation of methods for destroying the aphid, *Pentalonia nigronervosa* Coq., on bunchy-top infected banana stools was concluded. The standard Queensland method, in which kerosene is poured into the funnel leaf of the plant, was found to be quite adequate for the treatment of diseased plants.

Pests of Other Fruits.

In the Central districts, outbreaks of the fruit-piercing moths belonging to *Othreis fullonica* L., and other species, have been linked with heavy larval populations on a native vine, *Legnephora moorei*, which is widely distributed in coastal and sub-coastal areas. These pests caused extensive losses in citrus during 1938 in Central and Southern coastal fruit areas, but the position in 1939 has not been acute, though in the Central-West and far North losses have been greater than for some time past. Control measures are not fully satisfactory and work on this project is being continued.

The fruit spotting bug, *Amblypelta lutescens*, Dist., has been the subject of some small scale experimental work at Rockhampton, where papaws have suffered considerably. The plant reactions of gumming, splitting, and frequent dieback, are more acute where the papaws, for cultural or other reasons, are not making rapid progress. Control of this pest seems quite practicable if nicotine dusts are systematically applied when required, but close observations on bug populations and plant appearances are necessary for the correct timing of treatments.

A recrudescence of the bronze orange bug, *Rhaecocoris sulciventris*, Stal., occurred during the summer on the Blackall Range, but seemed localised to the south of Montville. Severe damage to fruit and young growth followed. The resin-caustic soda-fish oil spray was used fairly extensively in autumn, when the pest is most vulnerable. The way is now clear for more extensive use of this spray as a soft soap concentrate compounded to the official formula is commercially available. Normally the occasional use of this excellent general purpose spray in autumn should make outbreaks of the pest rare phenomena.

Pests of Vegetables.

The recently popularised white oil-nicotine sulphate spray for controlling bean fly, *Agromyza phaseoli* Coq., has been extensively used commercially in southern coastal Queensland, during the past year. In the earlier absence of a control measure for this pest, growing beans other than in late autumn, winter and early spring, was a speculative proposition, except in the Stanthorpe district. The introduction of the spray immediately led to an extension of the bean-growing period in coastal districts, and a provisional recommendation of the application of two or three sprays to the young plants frequently proved inadequate. This was not unexpected for a greater number of treatments had already proved necessary in North Queensland, where the climate is, of course, warmer. Spraying requirements for various periods of the year are being studied at Nambour, and conclusions should shortly be available.

The green vegetable bug, *Nezara viridula*, L., was rather abundant in spring in some parts of Southern Queensland, but more particularly on the Darling Downs, where high populations were recorded from various hosts. Field observations made at the time showed that the introduced parasite, *Microphanurus basalis*, Wall., was quite common and apparently acting as an important check on the pest. No difficulty was experienced in rearing colonies of the parasite for distribution to Central and North Queensland, and liberations were effected at Rockhampton, Bowen, and Cairns, where the pest has been troublesome in recent years. The parasite has now been recorded from Bundaberg, some 200 miles away from the nearest site of liberation, and one must assume that dispersal through trade channels in eggs on consigned vegetables has taken place on a fairly extensive scale.

Cereal Pests.

Sorghums are becoming increasingly important in Queensland, and during the 1938-39 departmental year, pests thereof required some attention. At Biloela a Cecidomyid, which is very similar to, if not identical with, the American sorghum midge, *Contarinia sorghicola*, Coq., proved very destructive to the grain types. An earlier record in 1930, from the Lockyer district, concerned the same insect, and observations at various field stations serving agricultural areas, indicate that the pest is common in all sorghum-growing districts, and causes a considerable amount of damage.

A widespread outbreak of the army worm, *Cirphis unipuncta,* Haw., occurred in spring, the infested area extending from the Darling Downs to the Callide Valley, though the injury was most serious in the former, where winter cereals are widely grown. Control measures are more or less standardised, an arsenical-bran bait being used. Farming activities were not unduly disturbed, except in isolated localities, primarily because excellent rains ensured an abundance of feed at the time of the outbreak and guaranteed a rapid recovery of most crops.

Sporadic outbreaks of the blue oat mite, *Penthaleus bicolor,* Froggatt, have occurred in wheat and oats on the Darling Downs. Either the pest has been more abundant than hitherto or earlier outbreaks have been localised and unrecorded.

Cotton Pests.

Further work on swabbing and dusting methods of controlling the major boll and leaf-eating pests of cotton were planned for the season, but pest behaviour has been quite extraordinary, and some phases of the work lapsed for want of adequate crop infestation, particularly by corn-ear worm, *Heliothis armigera,* Hb. The season opened well and spring populations of corn-ear worm were both early and somewhat higher than usual. Extremely dry and hot weather during December and January, however, though not affecting ultimate crop yields, played havoc with corn-ear worm in the more important cotton-growing areas. As a result the pest only became really destructive in isolated areas. Apart from one field experiment in which swabbing with the lead arsenate-molasses-water solution improved yields appreciably, it is questionable whether any significant results will be forthcoming from the 1938-39 programme. The maize trap crop experiments suffered the same experimental disability. Some worthwhile observations have, however, been gathered on corn-ear worm reactions to climatic vagaries.

The cotton jassid, *Empoasca terrae-reginae,* Paoli, proved more serious than for some time past, and many areas were heavily infested late in the season. Work on this pest at the Biloela Research Station is a joint project between the plant breeder and the entomologist, and strain resistance is a feature of present investigations.

Leaf-eating caterpillars were extremely numerous late in the season, some, e.g., *Anomis flava,* Fabr., which are normally of quite minor interest, being in plague proportions in some localities.

The pink bollworm, *Platyedra scutigera,* Hold., population increased enormously towards the end of the season and snap cotton arriving at the ginneries has been heavily infested. It is therefore imperative that the clean-up of cotton crop residues should be both thorough and complete to ensure the minimum of over-wintering in this species. Publicity has been given to this necessity.

Pasture Pests.

A number of pasture pests have warranted attention. Seed harvesting ant depredations in Rhodes grass areas have been the source of considerable loss in both alluvial and scrub soil plantings for some years. Investigations with repellants were therefore commenced at Biloela. *Pleidole impressiceps,* Mayr, appeared to be the dominant species at that centre, though several others were involved. Some readily available products are certainly repellent, but it is necessary to determine dilutions which give sufficient protection without adversely affecting the seed germination. Tar derivatives hold the greatest promise.

There is some field evidence that cultural methods have some bearing on ant depredations, in so far as they can influence both the soil cover over the seed and the rapidity of germination. Experiments comparing pre- and post- sowing treatments with various implements confirm these observations, and it seems reasonable to suppose that by the selection of suitable cultural practices and some of the more desirable seed treatments, losses may be appreciably reduced.

Results from such work may have an important bearing on a comparable problem on the Darling Downs, where *Pheidole ampla,* Forel, is frequently a disturbing factor in obtaining uniform stands of wheat.

The insect, *Psara licarsisalis,* Walk., is a Pyraustid that is generally distributed through the State, though it is seldom economically important. This year, however, it caused a threatening position in autumn pastures in Southern Queensland. Infestation was widespread, but the arsenical-bran bait, now familiar to most farmers, proved a quite satisfactory control measure. At Toogoolawah, a localised outbreak of the army worm, *Spodoptera exempta,* Walk., preceded the general influx of *Psara licarsisalis.*

White grubs, *Lepidiota caudata,* Blk., promise to be exceedingly destructive to pastures on the Atherton Tableland during the coming spring. Fortunately, recent work has demonstrated the practicability of growing and conserving ensilage crops and has given an impetus to improved practices which should tide many farmers over the critical period. Though white grubs are, and will continue to be, a problem, there can now be no doubt that in many parts of the district, a mixed farming programme is practicable, and, in fact, indispensible, for the profitable utilisation of the land.

Autumn plantings of lucerne were rather extensively attacked by the cutworm, *Agrotis ypsilon,* Rott., in Southern Queensland. Normally, *Euxoa radians,* Guen., is more commonly associated with this type of damage. Losses were not confined to lucerne, for reports of injury to autumn planted cereals and vegetable crops were received.

Work is under way to determine the vector of the virus associated with witches' broom in lucerne.

Lantana Insects.

The lantana bugs, *Teleonemia lantaniae* Dist., liberated at Kairi and Fairy Bower, in North and Central Queensland respectively, on behalf of the Council for Scientific and Industrial Research, continue under observation. At Kairi a single colony was released in 1936. During the past year, following a period in which the bug could not even be found, the numbers have increased considerably. The bug population has been sufficient to destroy the top growth of lantana over several acres. Fluctuating populations are probable, but it does seem as if the insect may, in some localities, assist in keeping

the lantana in check. Distribution from Kairi to areas north of Townsville has been authorised. At Fairy Bower the insects are permanently established and show signs of increasing to destructive numbers.

An indigenous Noctuid, *Hypena* sp., caused complete defoliation in an area of lantana at Blanch View, near the Toowoomba range. Larvae and pupae were, however, very heavily parasitised, and the outbreak suggests nothing more than a temporary lack of balance between the parasites and their Noctuid host.

Forest Pests.

Recent work both in Australia and overseas has proved conclusively that powder post beetle, *Lyctus brunneus* Steph., infestation in milled timber is largely dependent on the starch content of the wood. Methods of reducing the starch content of the bole of the standing tree before felling have therefore been further investigated. Exploratory tests at Stapylton on spotted gum indicated that high ringing, *i.e.*, ringbarking above the level of profitable utilisation, may lower the starch content to innocuous levels, and large scale experiments are now in progress at Dalby and Maryborough. Starch depletion has proceeded far enough. Six months after treatment at Maryborough, to allow safe felling, but a slightly longer period may be necessary at Dalby. There is at present every hope that logging programmes can be modified to permit the practice of high ringing, and thus the utilisation of timbers with a large proportion of sapwood which are particularly subject to powder post beetle deterioration. The work needs to be extended to other timbers, before the new principle can be generalised.

The pine bark weevil, *Acsiotes notabilis* Pasc., investigations current during the past two years have now been completed. The optimum temperature and humidity conditions for the development of each stage have been determined, and there can be little doubt that the rainforest temperature in all parts of the State favours development during the whole year, though activity is greatest in moist weather. With a revised method of pruning plantation hoop pine, the losses due to stub infestation have been almost completely eliminated. If thinning and pruning are carried out in dry winter and spring weather, bole injury through pine bark weevil infestation should be negligible. An improvement in current methods may be effected if thinnings are used as trap trees by cutting them some weeks prior to pruning.

Borer infestation, mainly *Platypus australis* Chap. and *P. froggattii* Samp., caused some concern in the Killarney logging area, where topography and rainfall often slow-up log haulage to the mill. Various log treatments with creosote, creosote combined with other chemicals, and proprietary products were therefore investigated, but present recommendations requiring the use of creosote, creosote emulsion, or a creosote-kerosene mixture, are unlikely to be superseded. Log treatment with insecticides in this particular instance was extremely difficult, and, except for special purposes, it is generally sounder policy to co-ordinate logging operations and milling so that the damage preceding utilisation is kept to a minimum.

The continuation of the work against the Queensland pine beetle, *Calymmaderus incisus* Lea, shows that annual applications of a solution containing equal parts of creosote and kerosene, if applied by injection or brushing methods, should normally eradicate the pest from infested hoop pine building timber.

Records of Interest.

Two pests of the Macadamia nut, namely *Candalides absimilis* Feld., and *Orgyia australis* Wlk., promise to become more important as the area under that crop expands. *Tortrix postvittana* Wlk., the lucerne leaf roller, has caused some leaf injury in strawberry crops on the North Coast. *Taeniothrips usitatus* Bagn. var. *cinctipennis* Bagn., was common on French beans in the Gympie area in spring. Two Oecophorids, *Philobota productella* Wlk. and *P. diaereta* Turn., were associated with localised pasture injury on the Darling Downs. *Chortoicetes terminifera* Wlk. has been of no importance during the year. Adults of the yellow-winged locust, *Gastrimargus musicus* F., however, were present in the Bowen-Townsville-Charters Towers sector in immense numbers, though with few important economic consequences as yet. Conditions there have been extremely dry. The Curculionid, *Tyrtacosus microthorax* Pasc., caused root and stem injury in hoop pine tubed stock at the Kalpowar forest nursery; the larvae burrow within the roots to considerable depths. *Prosphaeres aurantiopictus* L. & G., a Buprestid infesting hoop pine shortly after the trees are felled, has emerged from recently constructed dwellings very frequently during the year.

Apiary Inspection.

A new Apiaries Act and the associated regulations have been prepared and promulgated. Inspectional work was therefore resumed on a more intensive scale than for some time past. The industry appears to be growing, and as Queensland is singularly free from the more important widely distributed diseases and pests, the maintenance of a clean bill of health is imperative.

Insect Collection.

As additional cabinets became available further progress has been made in transferring the insect collection to more accessible positions. Acquisitions of new material from both the field stations and outside sources have been considerable.

Illustrations.

Illustrations for publication and exhibition purposes have occupied Mr. I. W. Helmsing's time fully during the year. Apart from those required for exclusively entomological purposes any necessary assistance has been given to other sections in the Division of Plant Industry (Research), to the Animal Health Station at Yeerongpilly, and to the Fruit Branch.

The valuable assistance given by the field staffs in Agriculture, Fruit, and Stock in supplying information on pest activities and collaborating in pest control programmes, is very much appreciated.

J. HAROLD SMITH,
Senior Research Officer (Entomological Section).

(5) REPORT OF THE HORTICULTURAL SECTION.

During the 1938-39 departmental year horticultural research activities have mainly been a continuation of work along the lines adopted in the previous year. In some instances, the actual field work was initiated during the year under review, following on laboratory work or a general survey of the problem at an earlier date. The chief investigational projects are discussed under the crops concerned.

Deciduous Fruits.

Deciduous fruits investigational work, which is being carried out in the Stanthorpe district has made considerable advance in certain respects.

The position regarding little leaf is now very satisfactory, and it is clear that, by the use of zinc sulphate as a spray in the dormant period of the trees' growth, the growers have at their disposal a highly efficient and economical corrective of the little leaf condition. As mentioned in last year's annual report, questions concerning the duration of the effectiveness of the treatment are of importance, but naturally these can be answered only by the passage of time. The incorporation of the zinc sulphate spray into general orchard practices has been worked out quite satisfactorily.

It was again impossible to carry out work on the problem of boron deficiency of apples, owing to the absence of this trouble during the comparatively favourable season that has just been experienced. As this deficiency has been rather rare during the past two years its comparative absence may be construed as meaning that it is of no importance. However, it must be borne in mind that, under certain conditions, the loss occasioned by the disorder is very considerable, and further that the variety chiefly concerned, Granny Smith, is an important export one.

The fertilizer experiments on both bearing and non-bearing trees have been continued, and although certain apparent differences have been noted, it would be unwise to draw any definite conclusions at this stage, and indeed it is not anticipated that concrete results will be forthcoming for at least two or three years.

In connection with the winter cover crop experiments, one of the greatest difficulties encountered is the unevenness of growth which has been noted in almost every instance. This makes experimental data rather difficult to interpret, and at the same time indicates that there are some more or less obscure problems to be faced, apart altogether from the question of cover crop varieties. Work is proceeding along the lines suggested as important by the results to date.

Major element deficiencies have been studied through the medium of pot cultures, and the trees grown under these controlled conditions are furnishing valuable data for the officers concerned.

The disorder of Santa Rosa plums which manifests itself in gumming of the branches and main stems has been the subject of experiments designed to show whether or not the trouble is caused by some plant food deficiency. A number of elements have been tested, particularly by the use of the injection technique, but so far no positive results have been obtained.

Work on wither tip of apples has yielded quite valuable results, and there appears to be no doubt that this trouble is due to a deficiency of copper. The data obtained this year have not yet been statistically anaysed, so that, at the moment, it is not possible to make any definite assertions as to the most efficient methods of overcoming this trouble. However, a cursory glance at the figures suggests that the results obtained may allow of definite recommendations being made in the near future. As with other deficiency troubles, the problem of the duration of the effectiveness of any one treatment has still to be faced.

With the completion of the more active work on the zinc and copper deficiencies it will now be possible to devote more time to the basic problems of soil management. It is felt that these soil management problems now constitute the most pressing horticultural research problems in the Stanthorpe district, and that before really satisfactory work can be done in other directions, it is necessary to have a sound knowledge of soil management as a foundation on which to build. Accordingly, the work in the Stanthorpe district is being directed to this end as expeditiously as is practicable.

Bananas.

The work on banana cultural problems has been furthered by the establishment of a fertilizer experiment at Buderim Mountain. In this experimental plot, which is on land that has been under cultivation for upwards of half a century, the design is such that information should be forthcoming on nitrogen, phosphoric acid, and potash as single elements and in the four possible combinations. The planting was made in December, 1938, so that no fruit has yet been harvested, but the plantation is in excellent condition, and there is every reason to believe that sound information will be forthcoming from it.

A considerable number of root surveys have also been carried out with a view to enabling a more intelligent approach to soil management problems being undertaken, and also to determine certain factors concerned with fertilizer placement.

Citrus.

The citrus fertilizer experiment was commenced early in the 1938-39 year at Mapleton, on trees which might normally be expected to be in full bearing, but which were in fact somewhat decadent. The first crop following the application, which will be harvested in the spring of 1939, cannot, of course, be expected to give any data on the effects of the fertilizer, as it was applied after the crop was formed. In laying down this experiment it was assumed from other results that nitrogen was a definite requirement, and consequently this element was given to all the trees.

The foliocellosis experiment which is being carried out at Gayndah was resumed, and

following another application of zinc sulphate as a spray, the trees are in excellent general condition, and it is anticipated that when the next crop is harvested it may be possible to claim positive and economic results.

The soil moisture work was continued at Gayndah.

During the last three months of the departmental year a survey of the physiological disorders affecting citrus fruits, with particular attention to the condition known as woody quarter, has been in progress. This malady in previous years has caused some concern to growers in several districts, but this year it is so rare that it is quite impracticable to carry out any investigational work on the trouble. Undoubtedly the most important apparently physiological trouble in citrus is the gumming of lemons, and following preliminary work the section is now in a position to formulate some plans for an investigation of this problem.

Malformation of mandarin fruit, which is accompanied frequently by a light setting of the crop, is also an important trouble, and consequently work thereon is included in the citrus investigational programme.

Drying out of orange fruits, which appears to be somewhat akin to the "granulation" of other States and countries, like woody quarter of mandarins, has been practically absent during the 1938-39 departmental year, so that at present there is no active work on that problem.

Papaw.

At the Bureau of Tropical Agriculture at South Johnstone, and at Nambour, progress has been made with studies of the papaw during the past twelve months. A large number of successful crosses has been made, and it is understood that seed production has been quite satisfactory at South Johnstone. A valuable set of data concerning fruit types has been obtained, and success has been achieved in producing seed desired for the propagation of types regarded as being of potential value. A strain of solo papaw, introduced from Hawaii and grown at Nambour, has been rather disappointing in so far as the type of fruit produced is concerned, and although its eating quality is quite satisfactory, the corrugated, poorly shaped fruit will never be of much value, and the chief interest in this strain will lie in its progeny through crosses with other varieties. The Betty variety, introduced from Florida, has produced a satisfactory crop of excellently shaped fruit with good rind characters, but so far there has been no mature fruit from this variety on which to judge its eating or culinary qualities. It is believed, however, that the Betty variety will prove to be a valuable addition to dioecious types in Queensland. The Singalese variety from Ceylon did not produce a very good type of plant, but this may have been due to the environmental conditions; and the fruit, which is still immature, appears to have a number of desirable characteristics. Of the local selections made, the one designated Nambour No. 1 has so far produced several trees which have yielded good type fruit of fine quality, though not of ideal texture.

From time to time, visits have been made to large papaw plantations on the near North Coast, and several selections have been made therein. A point most forcibly brought to notice in these surveys is the heterogeniety characteristic of every plantation, and the number of poor type papaws which originate from what is claimed to be superior seed.

There is no doubt that the first problem to be solved in connection with papaw culture is that of the production of desirable types, and the work for the 1939-40 departmental year is largely along such lines.

Work on asexual propagation has been continued, and has met with a large measure of success. Sections of unions show that there is no necessity for the cambium tissues of stock and scion to be adjacent at the time of budding, as secondary meristems are very quickly set up. An important problem in asexual propagation is constituted by the fact that the production of sap is so prolific that bleeding is profuse, and in the soft tissues of the papaw fungal and bacterial rots are consequently a menace. The problem of asexual propagation, therefore, is largely one of overcoming these bacterial and other rots either directly or indirectly.

As a number of fixed types are now available, a papaw field observation plot will be planted out early next spring in order to make comparisons of the field behaviour of the definite types. In addition to this, it is hoped to be in a position within the next six months to conduct a fertilizer trial, some of the essential preliminary information for which has been obtained from pot culture work done at South Johnstone.

Mango.

Mango work at South Johnstone, of which an officer of the Fruit Branch is in charge, has been advanced considerably. Success has been achieved with grafting trials and there are now sufficient trees to warrant the initiation of a field trial of varieties. A block of land has accordingly been secured at the Animal Health Station at Oonoonba, near Townsville, which should be quite satisfactory for this purpose and this land is being prepared so that planting may be done in the spring. In addition to this work, further surveys of the mango varieties in North Queensland have been made, and the records contain much valuable data on which to base the selection of desirable types.

Australian Nut.

The Australian nut observational work, recorded last year as being carried out at Buderim, has been continued. During the period under review an attempt was made to discover whether or not the major plant elements, added in large quantities, caused any differences in the size of the nut or in the thickness of the shell. The number of trees available and their disposition did not permit of a sound experimental block being laid out, and this work was regarded as observational rather than truly experimental. The final figures for the past season's crop have been received just recently, and it has not been practicable yet to examine the figures in detail, but, from the evidence so far obtained, there does not appear to be any indication that the main characteristics of any of the strains were appreciably altered by the applications made.

The vegetative propagation work carried out last year did not yield positive results, and it

became evident during the spring that the work would have to be repeated and extended. To this end, five strains of nuts were planted at Nambour for the purpose of raising stocks for use in the work. These stocks are progressing satisfactorily, and it is hoped that some at least will be ready for working in the spring of 1939. These stocks include some of the better types selected.

Avocado.

Definite progress has been made in work on the avocado. In last year's report mention was made of the introduction of seed of the Mexican and Guatemalan races. Very good germination was obtained of this seed, and during the autumn a considerable number of seedlings were budded with material taken from trees, the performance records of which were known. A number more will be ready for budding in the early spring, and there will then be sufficient trees to lay down an experimental block to test the behaviour of the varieties and their stock-scion relationships. Several growers have offered land for this purpose under highly satisfactory conditions, and it is anticipated that an efficient field experiment will be practicable in the 1939-40 departmental year.

Strawberry.

The strawberry fertilizer plot, which was conducted at Montville, did not yield a great deal of information with respect to the fertilizers themselves. The plot was, however, of very considerable value, in so far as it demonstrated the great variability in types in the normal strawberry field of this State. It became immediately obvious that before the horticulturist could hope to answer any questions concerning fertilizers on this crop, a great deal of work was necessary along the lines of plant selection. This was at once initiated, and at frequent intervals throughout the year, following the first selection, culling was practised. The great difficulty to be overcome was that there did not appear to be any available description of the main Queensland varieties, Aurie and Phenomenal, and growers generally appeared to be very confused on the matter. Following the selection and vigorous culling, another plot was laid down this year with the selected material. The growth of these plants very quickly demonstrated the value of selection. However, at the present time, there are two very good types of Phenomenal plant, but at the same time these are distinct from one another. The distinction so far is based wholly on the habit of growth, and whether this will be reflected in the yields remains to be seen when the harvesting of the crop is completed. If a marked difference in yield is characteristic then it is feared that again the fertilizer results may be inconclusive. At all events, further work on selection is planned, as well as work on fertilizers. The selection work has demonstrated very forcibly the value of culling plants showing any symptoms of virus diseases.

Passion Fruit.

The passion fruit fertilizer experimental plot yielded valuable and interesting data. The analysis thereof showed that vines which received complete dressings of nitrogen, phosphoric acid, and potash gave yields far exceeding those obtained from any other treatment, and statistically the difference was highly significant. Apart altogether from crop yields, the general health of the vines was such that the incomplete fertilizers were quite outclassed by the complete fertilizer in that respect. In so far as fruit setting was concerned, vines which received only nitrogen produced by far the greatest number of fruits, but only a small proportion of these came to maturity. The experiment definitely proved that nitrogen alone, phosphoric acid alone, or these two in combination were of no real value. The question of the value of the combination of nitrogen and potash in comparison with the complete dressing still remains to be answered, and consequently a second experiment was laid down in the late summer of this year to test these two combinations. No results, of course, are available from this experiment as yet.

Date.

Work on date palms is necessarily very slow, and as outlined in last year's report, palms of different varieties are being raised at the Biloela Research Station. It will be some years before there is anything concrete to report thereon.

W. A. T. SUMMERVILLE,
Senior Research Officer (Horticultural Section).

(6) REPORT OF THE PLANT PATHOLOGICAL SECTION.

Following the procedure adopted in previous years a brief summary is given here of the research activities of the Plant Pathological Section during the past twelve months. The name of the particular investigator concerned is associated with the different projects, which are for the sake of convenience listed under the name of the crop involved.

Cereals.

Most of the work on cereal diseases, referred to in the last annual report, has been completed.

An attempt to obtain further information on the effect of various seed dressings on the incidence of flag smut yielded disappointing results, owing to a very light infection with this disease, even in plots grown from artificially inoculated seed. In Queensland, the severity of this disease appears to be closely bound up with weather conditions, and in some seasons the disease is practically absent throughout the wheat belt. Further work along these lines will have to be postponed until suitable infected seed is again available.

The absence of a sufficiently high infection also made it impossible to obtain definite results from a varietal resistance trial in which a number of departmental wheat crosses were tested for resistance to flag smut and bunt.

Lucerne.

Considerable time has been given to a survey of the position with respect to disease in the lucerne crops of South Queensland. The main troubles are witches' broom and a series of root rots.

Witches broom is a virus disease which is now fairly generally distributed, and it may become a serious factor in production in older stands of lucerne. In order to obtain information on the development and spread of this disease, periodic notes were taken in an observation plot established at the Queensland Agricultural High School and College at Lawes. Plans have also been made to test the possibility of mechanical transmission of the disease, a point which apparently has so far received little attention. The possible occurrence of insect vectors is the subject of inquiry by officers of the Entomological Section.

Several distinct types of root trouble are capable of producing a yellowing and death of individual lucerne plants. One of them, occurring in experimental plots at Lawes, is of unknown origin. Two others are due to the well-known organisms *Sclerotium rolfsii* and *Helicobasidium purpureum*, respectively. The former has a fairly extensive distribution and is probably responsible for a definite reduction in stand in some instances. The latter is only known to occur in one farm. Owing to the potential danger of this disease, experiments have been carried out to test the value of soil sterilization for controlling its spread. If these are successful, an attempt will be made to eradicate the disease by means of rotation and soil treatment.

Peanuts.

The mercurial seed-dressing procedure for preventing germination losses and wilt has been adopted extensively in commercial plantings, with uniformly good results. It is anticipated that by next season practically all Virginia Bunch seed will be thus treated.

Attention is now being given to a survey of the other diseases present in this crop. The more common ones are of a virus nature and of these three distinct types may be recognised. None of these, however, appears to be identical with rosette. At the present time these diseases are responsible for very little loss, but it will be necessary to keep them under observation as any conditions leading to their rapid spread might render them of serious consequence.

Tobacco.

No experimental work has been carried out with tobacco by this section during the past year, although a number of minor troubles have been investigated. Field trials comparing the different methods available for the control of blue mould have been conducted in co-operation with officers of the Agricultural Branch. It appears that when frog-eye (*Cercospora nicotianæ*) is a factor to be reckoned with, spraying with colloidal copper supplemented by benzol fumigation during excessively wet periods is to be advised. In the southern portion of the State where frog-eye is rarely of importance, the benzol method should take precedence.

A further trial of a number of seedbed cover dressings was instituted in order to correlate previous results with work on mildew prevention recently reported from New Zealand. Final observation will be made on these tests shortly.

Banana.

No new investigational work has been undertaken in connection with bananas. The attention of the Senior Research Officer has been given to rounding off a number of projects, and summarising the data with a view to placing the information on record by publication.

An extensive bulletin dealing with black end and anthracnose is now in the course of publication.

As a result of a renewed interest in spraying for the control of leaf spot (*Cercospora musæ*), data collected some years ago relating to the influence of weather and seasonal conditions on the development of this disease has become of considerable interest. This information has now been correlated and presented in graphical form, and it is hoped to have it available for publication at an early date.

Several obscure points regarding the distribution and host range of the pathogenic and non-pathogenic strains of *Nigrospora sphærica* still await elucidation, and evidence regarding these has been obtained as opportunity permitted. It is thought that sufficient information will soon be available to satisfy the requirements

of the problem, at least from the practical point of view, and consideration will be given to preparing a report on the subject then.

Citrus.

A considerable amount of experimental work in connection with citrus has been done during the past twelve months. Most attention has been given to the development of the home-made colloidal copper spray for use on citrus. Some modifications in its method of preparation have been evolved, which enable it to be combined with certain of the scalicides in common use. This new formula was tried out last season on brown spot of the Emperor mandarin at Howard, using a fungicide-scalicide mixture at full strengths of all constituents, and successful control of the disease was obtained without any ill effects from the combination.

Fruit from a spraying trial carried out at Howard over the 1936-37 season was harvested in August last, and counts demonstrated the effectiveness of a two-spray schedule of colloidal copper as a control for black spot This spray was equal in efficiency to the standard Bordeaux mixture. Further information on the control of black spot will be available from an experiment at present under way at Woombye. Almost every season serious losses from black spot are sustained where copper sprays are not used. With the proved advantage to be obtained from the colloidal copper schedule these losses should no longer be unavoidable.

A spraying experiment, involving the use of home-made colloidal copper with and without a spreader and at half strength, a proprietary cuprous oxide, and Bordeaux mixture, was laid down at Woombye with the object of comparing the efficiency of these sprays for the control of melanose. Seasonal conditions were such that only a light infection with melanose occurred but comparisons will be possible. However, a moderate infection with black spot will enable results to be obtained with respect to this disease.

Following on the previous year's work, a further trial of the compatibility of colloidal copper and Bordeaux mixture with cyanide fumigation was carried out at Gayndah. Owing to the prevalence of very dry weather during the latter part of the year results were not as precise as could be desired. However, analyses of the spray residue on leaves from the Gayndah plot and from another spraying trial at Woombye threw considerable light on the different results associated with cyaniding after applications of the two copper sprays mentioned.

A further attempt to accurately assess the effect of copper sprays on scale infestation was carried out at Howard, where colloidal copper and Bordeaux sprays were compared in a block of Valencia oranges. Unfortunately, the scale population was very low and results were again inconclusive.

A skin blemish affecting lemons in the Gayndah district was investigated. Field data showed that the disease appeared immediately after two or three days' rain when the fruit was nearly mature. This disease is evidently allied to the rind breakdown of mandarins, referred to in last year's report. The latter was again prevalent following early winter rains.

Pineapple.

Investigations regarding the fruit diseases causing losses at the pineapple canneries were continued. These included brown speck, marbling, and black heart.

Field inoculation trials carried out at Manly with the organism principally responsible for brown speck disease (*Penicillium sp.*) have shown that infection takes place during the flowering stage. Typical lesions are not produced until the fruit is reaching maturity, and they vary greatly in extent in different fruits. There are evidently various factors influencing the post inoculation development of the disease, and an attempt is being made at present to elucidate these in a series of field and laboratory experiments. Both *Penicillium sp.* and *Fusarium sp.* occur in a saprophytic capacity on the plant in the field, and a certain amount of evidence is now available to indicate the means by which penetration into the fruit takes place.

Further field inoculations with the bacteria responsible for marbling disease were carried out with a view to finding some reason for the marked fluctuation in the incidence of the disease. The variation in resistance shown by individual fruit was not sufficient to account for this fluctuation, and it is considered that conditions obtaining during the flowering stage, when natural infection probably takes place, exert a determining influence. The mere presence of the bacteria on the flowers is not sufficient in itself to ensure infection. Further experiments along these lines are in progress. Artificial inoculation has shown that typical symptoms of marbling can be produced in the Ripley variety of pineapple.

Work on black heart has been mainly concerned with attempts to ascertain what conditions are most conducive to its epidemic development. Shading experiments have shown that insufficient sunlight is evidently a contributing factor. Previous observations on the correlation of serious black heart development with poor quality of the fruit were confirmed. The black heart problem is further discussed in the report on the work of the Plant Physiology Section.

It has been found that following certain weather conditions in the field an appreciable amount of water blister (*Thielaviopsis paradoxa*) originates in growth cracks, and case bruises on the side of the fruit, and is not controlled by the standard treatment of the cut stem with benzoic acid. An attempt to eliminate this infection by means of alterations in packing procedure and the total immersion of the fruit in a fungicide was made. Shirlan A.G. at a strength which was toxic to the spores of *T. paradoxa* when used in laboratory tests did not give 100 per cent. control when used on heavily artificially inoculated fruit in the field. It is thought that with a lighter inoculum more favourable results would be obtained, a point on which it is hoped to obtain information next summer.

Papaw.

Early in the present year an investigation of papaw diseases as a major project was undertaken, and this arrangement will enable much greater attention to be paid to the pathological troubles associated with this crop. A general survey of the position is a first necessity, and is at present being carried out. It would appear that the main subjects for investigation will be dieback and the ripe fruit rots.

Dieback has, fortunately, not been so serious this year as during the corresponding period in the 1937-38 departmental year. Investigations have so far been limited to making field observations on the development of the disease.

Fruit rots continue to be a common source of loss in fruit after it has reached the retailer, and are especially serious in consignments sent to Southern markets. In addition to commencing a survey of the organisms chiefly concerned, a spraying experiment designed to ascertain whether consistent spraying with colloidal copper throughout the growth of the crop will materially affect the incidence of the disease was initiated. This should form a basis for more detailed work next season.

Yellow crinkle continues to be responsible for the loss of odd plants, but did not appear in epidemic form during the past year. As opportunity offers, it is proposed to test the effect of systematic rogueing on the incidence of the disease and also to attempt to ascertain the method of spread. The suspected new virus mentioned in the last annual report has made its appearance again this year, and is being kept under observation.

Through the courtesy of a papaw grower at Manly, observations are being made on the effect of commercial applications at various intervals of sulphur and sulphur-copper carbonate dusts on powdery mildew. This will supplement previous information obtained from small scale departmental experiments.

Deciduous Fruit.

As a result of exceptionally dry conditions during the ripening of the late varieties, brown rot was practically absent, and results were accordingly negative. Incidentally, the value of an early spray of Bordeaux mixture or lime sulphur for the control of leaf curl in peach and nectarine was demonstrated.

Bacterial spot of plums was serious in susceptible varieties when spraying had been neglected or inefficiently done. On the other hand, where departmental recommendations had been carried out a pleasing freedom from the disease was to be noted.

Strawberries.

A brief survey of the position with respect to the incidence of virus diseases in the strawberry crop was made. Yellow edge and crinkle were prevalent on the South Coast, the former predominating. Very little crinkle was found on the North Coast, though yellow edge was fairly common. Correct diagnosis was rendered difficult by the presence of a number of abnormalities resulting from climatic and cultural factors. It is thought that under the conditions pertaining in Queensland neither of these virus diseases need become serious, provided adequate attention is given to rogueing and to the selection of healthy mother plants.

A previously unrecorded fruit spot was investigated, and it was ascertained that the fungus *Diplocarpon earliana* was the cause. The fruit spot and typical leaf scorch symptoms were reproduced by inoculation.

Tomatoes.

Main projects have included a comparison of the various fungicides used on tomatoes, and work on Fusarium wilt and bacterial wilt.

In connection with the fungicide investigations, spraying trials were carried out in the Rochedale, Manly, and Redland Bay areas. The disease incidence was on the whole light, but information on several points of interest was obtained.

In a comparison of Bordeaux sprays prepared with different proportions of lime, the 4-8-40 mixture did not show any better adherence of the copper on the leaves than either the 4-4-40 or 4-2-40 mixtures. Irish blight (*P. infestans*) was controlled equally well by all three.

Home-made colloidal copper when compared with Bordeaux mixture proved to be as efficient a fungicide and did not appear to have as adverse an effect on yield as the latter spray.

With regard to the two types of dust, copper carbonate-kaolin and copper sulphate-hydrated lime, the former apparently does not affect the growth of the plants as much as the latter, thus resulting in a slightly higher yield of fruit. On the other hand the sulphate dust appears to be slightly more efficient in the control of target spot (*A. solani*) on the fruit.

The application of copper fungicides in the form of wet sprays was compared with their application as dusts. The sprays showed superior adhesion to the leaf and a slight superiority in the control of target spot (*A. solani*). The dusts resulted in yields superior to Bordeaux mixture but inferior to colloidal copper.

The testing of different varieties against various strains of the Fusarium wilt fungus (*F. lycopersici*) has been continued. The outstanding variety as regards resistance to wilt has, so far, proved to be Rutgers. In addition, some of last year's selections have been compared with the original stock using two of the most virulent strains of the fungus as a source of infection. Consistent improvement was manifested in some cases and variability in others.

On two farms heavily infected with bacterial wilt an attempt was made to control this disease by soil treatments with sulphur. No commercial control was effected, though the development of the wilt in the treated plots was delayed some seven to ten days. The control depends on increasing the soil acidity to a point inimical to the growth of the parasite, and then reducing the acidity again with lime before planting. It is thought that with the conditions occurring

during the experiment the period at which the soil was subjected to the high acidity was not sufficiently long, and the experiment is being repeated, using a much earlier application of sulphur. Cold weather and abnormal rains during last winter were responsible for conditions detrimental to normal growth, and a considerable amount of root rot, with which *Rhizoctonia* and other organisms were associated, was an indirect result.

Verticillium wilt has proved to be more common than was previously thought to be the case.

Vegetables.

A project to control pumpkin stem rot (*Fusarium* sp.) by means of liming infected soil had to be abandoned through the failure to obtain a suitable location for the experiment. However, field observations suggested that where liming had been practised and abnormal acidity corrected a reduction in the disease occurred. This disease has been recorded also from watermelons and marrows.

Onion smut (*Urocystis cepulæ*) was recorded for the first time during the past year.

Forestry.

Investigations in connection with fused needle have been continued and elaborated. Further confirmation has been obtained of the beneficial results of dressings of phosphatic fertilizers, and in some of the plots there is now a complete recovery from the fused needle condition. The effect of applying various other forms of fertilizer has also been investigated. The nutritional origin of fused needle is considered to be definitely established.

A number of seedlings have been raised from fused needle-affected parent plants with the object of determning whether there is an inherited susceptibility to this disease. All these seedlings were of an abnormal colour at germination, but developed normally thereafter. Cuttings from diseased and healthy plants are being propagated with the same object in view.

An experiment was instituted at the Gadgarra nursery, in North Queensland, to determine whether maple gall could be controlled by any of several different seedbed treatments. Owing to heavy rains in North Queensland at the time of seed sowing, results were entirely negative and the experiment will have to be repeated.

Observations carried out in North Queensland on root rot (*Fomes pachyphloeus*) in maple, kauri pine and hoop pine, have indicated that the incidence of the disease decreases when the stumps of rain forest trees, left after the burn, reach an advanced state of decay. At this stage it appears that the organism responsible for the rot loses a considerable amount of its activity.

Two forms of chlorosis in hoop pine seedlings have been investigated during the year. A lime induced chlorosis occurred in two nurseries. In one case, this was traced to the alkaline nature of the water available for watering purposes. The application of sulphur proved effective as a temporary remedial measure for use until the nursery can be removed to a more favourable site. In the second case, the alkalinity was due to the upward movement of soil salts under conditions of high evaporation, low rainfall, and frequent light waterings. A control was effected by leaching the soil with heavy watering.

The other type of chlorosis was due to a deficiency of nitrogen brought about by the use of a sawdust cover for the seedbed. The organisms responsible for the breakdown of the cellulose used all available nitrate at the expense of the plant. A dressing of ammonium sulphate remedied this effect.

An experiment was carried out at Yarraman to compare the efficiency of the fungus isolated from hoop pine mycorrhiza and *Boletus granulatus*, as regards mycorrhiza formation in hoop pine. No difference was obtained in any of the plots including naturally infected soil, and it is considered that the mycorrhizal fungus of hoop pine is probably closely allied to. if not identical, with *B. granulatus*.. It is of interest to note that the typical *B. granulatus* mycorrhiza on *Pinus* is ectotrophic while on *Araucaria* it is entotrophic.

A fungus has now been isolated from the mycorrhiza of *Pinus taeda* plants obtained from their natural habitat in the United States. It is proposed to see if there is any significant response to inoculation with this fungus, as compared with the mycorrhiza formers naturally present in Queensland.

It was shown, experimentally, that the timber used in the construction of the cases used as egg containers, even when badly sap-stained, did not influence the deterioration of the eggs due to. mould rots. Treatment of eggs with Shirlan A.G. showed that the initial contamination in the majority of instances was on the shell of the egg itself.

General.

During the past year there has been a considerable call for cultures for the inoculation of legumes, chiefly lucerne and soya bean. For the two crops mentioned, proved cultures are available. In other cases cultures have been supplied from stock received from America.

J. H. SIMMONDS,
Senior Research Officer (Plant Pathological Section).

(7) REPORT OF THE PLANT PHYSIOLOGY SECTION.

During 1938-39, the activities of the Plant Physiology Section have been chiefly directed towards continuing the programme of research into pineapple problems, which was made possible largely as a result of financial contributions from growers, canners, and other interested bodies. It was indicated in last year's annual report that the pineapple programme which had been adopted included three main lines of investigation, namely—(1) Cultural studies, including work on nutritional and soil problems; (2) Plant selection studies; (3) Studies on fruit quality in relation to disease incidence. During the past year, however, it became apparent that the purely pathological aspects of the fruit disease studies were assuming greater importance than had been anticipated when the original programme was drawn up. Accordingly, it was decided that the whole of the disease problems associated with pineapples should be investigated by the Plant Pathological Section.

As the work on pineapple plant selection has, since its inception, been carried out at Nambour by an officer of the Horticultural Section, the staff of the Plant Physiology Section is now solely engaged on nutritional and soils investigations. However, the relegation of the pathological and plant selection projects of the pineapple research programme to their proper investigational units within the Division of Plant Industry (Research) has been effected without any curtailment or modification of the programme as originally drawn up. Frequent consultations with the senior research officers in charge of the Plant Pathological and Horticultural Sections of the Division, and with the officers in these sections actively engaged on the investigations, as well as with the Director of Fruit Culture, ensure the maximum degree of co-ordination between the various lines of inquiry.

Some attention is being given to the physiological and soils problems affecting—(1) the cultivation of papaws in the metropolitan area, and (2) the production of winter fodder crops in pastoral districts on the Darling Downs. As in the case of the pineapple investigations, the programme of work which has been initiated in connection with papaw-growing has been made possible largely through the financial support of the growers themselves.

Pineapple Production During 1938-39.

The production of pineapples in Queensland during the past twelve months has shown a marked increase over that for the corresponding period in 1937-38. While local and interstate fresh fruit markets have provided an outlet for some of this increased production, the greater part of it has been available for canning. Consequently, a comparison of the quantities of fruit which were handled by the canning factories during the past two years indicates the extent to which production has been increased. Expressed in terms of one and one-half bushel cases, these quantities are as follows:—

Year.	Winter Crop.	Summer Crop.	Total.
1938-39	331,835	429,656	761,491
1937-38	119,095	357,515	476,610
Increase during 1938-39 over 1937-38—	212,740	72,141	284,881
Percentage increase—	178·6	20·2	59·8

Although the 1939 summer cannery crop constituted a record, being 20.2 per cent. in excess of the previous summer's crop, which was also of record proportions, the margin between these two crops would probably have been far greater had it not been for the very dry conditions which obtained in all the main producing centres until the latter part of February, by which time the bulk of the summer crop was approaching maturity. In consequence, the average size of the individual fruits was considerably smaller than it was during the previous summer crop.

Another factor contributing to the smaller average size of the fruit in the 1939 summer crop was the cutting down in the use of fertilizer during the previous spring, consequent on a big reduction in the price being paid for pineapples for canning. The full effects of this factor are difficult to estimate, since the extent to which expenditure on fertilizer was curtailed varied greatly between individual growers. Observations made prior to and during the harvesting of the crop suggest that growers who maintained their fertilizer applications at the rates recommended by this Department were more than compensated for their outlay by the heavier yields which resulted, because of the larger average size of the fruit harvested. However, in these instances the advantages accruing from the use of adequate fertilizer are likely to become accentuated in the succeeding crop, owing to the stimulus given to the sucker growths.

Pineapple Field Demonstration Plots.

From 1936-38 the field work undertaken by this Department in connection with the pineapple investigational programme was largely directed at disseminating data obtained from previous investigations regarding the cultural practices best suited for this crop under Queensland conditions. The greater part of this field work has taken the form of a series of demonstration plots, each approximately one-third of an acre in extent, of which a total of thirty-two are now located in various parts of the State. The layout of these plots and the objectives sought have been summarised in the last two annual reports. That they are fulfilling the purposes for which they were laid down is indicated by the increasing production and a general improvement in fruit size and quality.

During the past year, two additional demonstration plots have been laid down, one at Buderim and one at Nikenbah, but two of the

earlier ones have been discontinued. In spite of abnormal seasonal conditions—viz., exceptionally heavy late rains during the latter part of May, 1938, and prolonged dry conditions during the early part of last summer, growth on the plots has generally been good. However, two plots planted in 1936 which are located on re-plant land in the Nambour and Buderim districts, respectively, have proved most disappointing, large areas in each having collapsed with wilt. Investigation has shown that these failures can be correlated with soil conditions, particularly with the ratio between field moisture capacity and wilting co-efficient. Work which has been carried out on the significance of these factors in assessing the suitability of a soil for pineapple culture is discussed in another section of this report. The failure of the Buderim plot was apparently due to the abnormally high wilting co-efficient of the soil, 22 per cent., coupled with prolonged dry periods, and it has strikingly demonstrated that colour, depth, texture, or the apparent fertility of a soil as measured by chemical analysis, are unreliable indicators of the suitability of a soil for pineapple-growing when considered apart from soil-moisture relationships. Paper mulch was not used on the plot which was laid down at Buderim in 1936, when only very small quantities of the material were available. Results obtained from the use of paper mulch on demonstration plots laid down in 1937 in other districts have suggested that the employment of this method of soil moisture conservation on Buderim soils might go a long way towards overcoming their inherent high-wilting co-efficient. Accordingly, a second plot was laid down in this district in November, 1938, which incorporated both mulched and unmulched areas for comparative purposes. The progress of this plot to date has been most satisfactory, in that growth differences between the mulched and unmulched portions are already well marked.

Harvesting of the plant crop of all ten of the demonstration plots laid down in November-December, 1936, was completed during the past year, and, in addition, varying percentages of the plants in most of the paper mulch plots laid down at the end of 1937 also fruited during the past summer. Of the 1936 plots, the one which gave the heaviest yield was located on a property at Woombye. This plot was planted on 2nd December, 1936; no paper mulch was used, and 2,232 plants which had been propagated from large-sized slips were treated with acetylene on 18th October, 1937. Between 21st February and 30th October, 1938, a total of 2,143 fruits were harvested from these plants, aggregating 10,099 lb. and averaging 4 lb. 11.4 oz. per fruit with the tops on. The peak harvest period was from the middle of April to the middle of May, 1938, and 68.5 per cent. of the plant crop matured between 9th March and 13th June. As this planting was made at the rate of 15,660 plants per acre the yield, calculated on an acreage basis, was 31 tons 12 cwt. It is anticipated that harvesting of the second crop, or first ratoon, from this plot will be completed by 31st October, 1939, and present indications are that the rate of yield will closely approximate that obtained for the plant crop. None of the plant crop yields from the other demonstration plots laid down in 1936 were at a lower rate than 20 tons per acre, with the exception of the two noted above and one at Palmwoods. Smoke from a grass fire on an adjoining field caused many of the plants in the last-named plot to flower prematurely, shortly after planting, and this resulted in a much lower plant crop yield being obtained than would otherwise have been the case.

The paper mulch demonstration plots which were laid down in 1937 exhibit differences in growth from district to district, according to variations in soil type and climatic influences, but in all cases they compare very favourably with the best plantings of similar age in their respective districts. In this connection, attention again may be drawn to the fact that all except one of the plots which were laid down in South Queensland in 1937 were located on land which had carried one or more plantings of pineapples previously. The use of paper mulch has shown to particular advantage on soils known to possess a low moisture equivalent-wilting point ratio, *e.g.*, Beerburrum soils. In this district four double rows of one of the 1936 plots were planted in paper mulch and the contrast between these rows and the adjoining "no mulch" planting, though always marked, has become greatly accentuated since the harvesting of the plant crop was completed. Wilt has developed in several places in the "no mulch" planting, but it has not yet made its appearance in the mulched rows. The latter, moreover, have suckered well and the growth of the suckers is, generally, most satisfactory.

Pineapple Fertility Trials.

The major experimental project undertaken during the year under review has been the establishment of a comprehensive series of pineapple fertility trials at Glasshouse Mountains. The scope of these trials embraces, in some degree, the various lines of research being pursued individually by all officers attached to the Plant Physiology Section, as well as certain aspects of pineapple fruit disease problems. Primarily, the trials are based on the need for more precise information regarding the fertilizer requirements of pineapples under local conditions. The trials have been planned in such a way that the results, when correlated with soil and climatological data, should be applicable in some degree to any part of the coastal belt of the State. Specifically, attention is being directed towards the elucidation of the following points bearing on the fertilizing of pineapples:—

(1) The relative proportions in which the essential mineral plant foods should be present in a soil in order to obtain maximum results.

(2) The percentage increases in yield which result from additional increments of fertilizer when applied either singly or in combination.

(3) The depression in yield, if any, which results when nitrogen, phosphoric acid, or potash is applied in excess.

(4) The economic limits to which fertilizers may be applied in relation to the price obtained for the product.

(5) The degree of accuracy with which the fertilizer requirements of a given pineapple soil may be determined by mathematical calculations based on data derived from chemical analyses.

(6) The effect of varying proportions and amounts of the several fertilizer ingredients on fruit quality, on the incidence of fruit diseases and blemishes, and on the period of ripening.

(7) The influence, if any, of various fertilizer treatments on the carrying and keeping qualities of the fruit.

The trial area extends over one and one-half acres of second cycle land of the Glasshouse sandy loam, and the layout consists of eighty randomised plots incorporating sixteen different fertilizer treatments, each replicated five times. Prior to planting, intensive soil sampling of the area was carried out so that analytical data would be available regarding variations in the chemical and physical constitution of the soil from plot to plot. It was found that such variations as existed were of a very minor character only. Other soils investigations which are being carried out in connection with these trials are outlined in a subsequent section of this report.

Planting was carried out between the 1st and 10th of November, 1938. All planting material used was individually weighed prior to stripping and graded accordingly. Fertilizing of the plots has been carried out according to a pre-determined schedule, and five applications have been given to date. The fertilizing technique involves the use of calibrated measures, each plant receiving a fixed quantity at each application. Growth differences are already apparent throughout practically the whole of the series of treatments. These differences are most pronounced in the treatments involving low levels of nitrogen, but they are also noticeable in the potash series, and, to a lesser extent, in the phosphoric acid series. A large number of leaf measurements have been made and these show that differences of up to half an inch occur in the average width of leaves in different treatments. It is anticipated that a considerable proportion of the plants in these trials will flower next September and October, so that some data on the plant crop should be available during the coming year. However, it is proposed to continue the experiments over a cycle of three crops, *i.e.*, four and one-half years.

Pineapple Soils Investigations.

Soils investigations having special reference to pineapple culture have formed a major part of the laboratory work which has been carried out by this section during 1938-39. The information obtained from this and the previous survey of the Beerburrum-Glasshouse Mountains-Beerwah area has proved of great practical value in the interpretation of specific soil problems, since the large area covered by the surveys includes a wide range of soil types which are all being used for the same purpose, viz., pineapple-growing. Not only have the soil surveys shown the close relationship which exists between soil type, *i.e.*, physical characteristics, and economic production, but they have also revealed that only in a very few instances in the districts surveyed is there a significant difference in the available nitrogen, phosphoric acid, and potash content of soils, which, as experience has shown, vary considerably in productivity when planted to pineapples.

Of the purely physical properties of a soil, its moisture relationships rank as among the most important and *a priori* considerations suggest that a knowledge of these relationships for varying soil types should provide a basis for comparing their crop-producing potentialities. Accordingly, an intensive study of the soil-moisture relationships obtaining in several distinct soil types has been undertaken with a view to securing data which might be related to crop production. For several months past, soil samples from selected areas have been taken for moisture determinations at regular fortnightly intervals. In addition, the wilting co-efficients of these soils have been determined. The data so obtained has made it possible to correlate fluctuations in soil moisture with the moisture equivalent, or field moisture capacity, and with climatic data calculated in terms of monthly rainfall-evaporation ratios, and thus provide a means of postulating both the percentage of the soil moisture which is available to the growing crop and the period for which it is available. Previously noted variations in the relative crop-producing capacities of such soils as the Glasshouse sandy loam, Beerburrum fine sand, and the Buderim loam, when subjected to comparable fertilizing and cultural treatment, can now be satisfactorily explained on this basis. As rapidly as circumstances permit, data on moisture relationships is being obtained from soils in other areas, with the object of ascertaining the period of the year during which the moisture content of these soils is at or near the wilting co-efficient. As little or no moisture is available for crop requirements at this point it is evident that such data provides a measure of the suitability or otherwise of a soil for pineapple culture, quite apart from considerations of chemical fertility. In addition, it gives an indication as to the probable benefits which will accrue from the employment of moisture-conserving practices, such as the use of paper mulch. Obviously, however, data of this character is applicable not merely to a semi-permanent crop such as pineapples but to all other crop plants, whether annual or perennial. On Buderim Mountain, for instance, annual crops having a short growing period which coincides with the rainy season may be relied upon to give satisfactory yields in any but a very abnormal season, whereas those with a longer growth cycle, particularly shallow-rooted plants such as the pineapple, frequently may have to contend with periods when the available soil moisture is insufficient for their full requirements.

Elucidation of the role played by certain soil factors in crop production forms an important part of the pineapple fertility trials which

have been laid down at Glasshouse Mountains. These trials, as already mentioned, consist of eighty plots and, prior to planting, a composite soil sample from each alternate plot was subjected to chemical analysis to determine the degree of uniformity which existed over the area. Since planting, similar analyses have been made on samples taken at six-weekly intervals from fifteen type locations scattered throughout the area. This has made it possible to keep a record of the fluctuations occurring in the available nitrogen, phosphoric acid, and potash content of the soil. Soil moisture determinations have been made regularly at fortnightly intervals since planting these plots, for the purpose of comparing the moisture content under paper mulch with that in exposed soil. It has been found from these studies that, following the commencement of the summer rains, a period of five weeks elapsed before the soil under the middle of the mulch strips reached its moisture equivalent.

Field Experiments on Crookneck Disease.

During the past year, field experiments on the deficiency disease of young pineapple plants known as sclerosis or crookneck have been continued on a plantation at Elimbah. The symptoms of this disease were briefly described in the last annual report. Previous experiments showed that while periodical spraying with boracic acid reduced the incidence of the disease it did not entirely prevent its appearance. During November, 1938, further trials were laid down for the purpose of testing the effect of applications of zinc to the growing plants following on a test planting of maize, which indicated that the soil was deficient in this element. In these trials zinc sulphate was applied in two ways—(1) as the crystalline salt mixed with fertilizer, and (2) in the form of a spray. Responses have been obtained with both methods of application, but those resulting from the application of the dry salt mixed with fertilizer have proved markedly superior to those obtained from spraying. In this connection it should be noted that one factor which appears to have an important bearing on the relative efficacy of the dry and spray zinc treatments for the prevention of crookneck appears to be the time of application in relation to the age of the plant. Dry zinc sulphate was applied with the fertilizer within three weeks of planting, while plants of the same age had not reached a sufficiently advanced stage of growth to permit of spraying until they were two and one-half months old. Despite the fact that these plants received additional applications of zinc spray at approximately monthly intervals thereafter, the treatment has not entirely prevented the appearance of crookneck symptoms, as was the case where crystalline zinc sulphate was incorporated in the first application of fertilizer. Leaves which have developed since the spray treatment was commenced, however, do not exhibit sclerotic symptoms on the sprayed plants to the same extent as they do on plants in the neighbouring check rows. Application of zinc sulphate with fertilizer shortly after planting has not only prevented the development of the typical sclerotic symptoms, but has also effected a marked improvement in both the colour and general vigour of the plants.

Water Blister Disease Investigations.

For several years past, the disease of pineapple fruits known as soft rot or water blister has caused heavy and progressively increasing wastage in fruit consigned to the Sydney and Melbourne markets during the summer months. Coupled with the assertion that the measures which have been recommended for the control of this disease are no longer effective, varied and conflicting opinions have been advanced regarding the reasons for its increasing severity. In response to requests from growers' organisations, an investigation of the factors involved in the development of water blister in pineapples while in transit to interstate markets was undertaken in Sydney and Melbourne during February and March last. The main point brought to light in the course of these investigations was that the serious increases in losses from water blister which have occurred in recent years appear to have resulted from a proportionate increase in the percentage of side or skin infections as compared with stem-end infections. At the time that the previous investigations on this disease were carried out during the years 1928-1930, it was estimated that the latter type of infection accounted for 75 per cent. of the total wastage from the disease. Observations made during the past summer indicate that the position is now reversed. In seven experimental consignments, aggregating 3,629 fruits, which were examined in either Sydney or Melbourne, only one stem-end infection occurred, compared with a total of 921 side infections in all treatments. Thus it is clearly indicated that dusting the cut stem-ends of pineapple fruits with a fungicidal substance, such as a mixture of benzoic acid and kaolin, no longer provides an adequate safeguard against losses from water blister. It has been found that the extent to which side infections may occur varies with (1) the degree of contamination of the fruit with the spores of the causal fungus, and (2) the degree of care exercised in picking and packing.

Contamination of the fruit with the spores of the causal fungus during transit to the markets was not found to increase the incidence of the disease in fruit examined up to eight days from the time of picking. It was further found that, without resort to any protective measures other than care in picking and packing, the incidence of water blister could be reduced to under 2 per cent. at times when artificially surface-contaminated fruit was showing wastage of from 90 per cent. to 97 per cent. Experiments directed towards evolving a means of protecting fruits from side or skin infections were instituted at the conclusion of the Sydney and Melbourne investigations. Because of decreasing seasonal temperatures it was found necessary to discontinue these experiments before any degree of finality had been reached. The work has advanced sufficiently,

however, to indicate that the problem of obtaining complete control of water blister is complicated by (1) the limitations which Public Health legislation necessarily imposes on the range of fungicidal substances which might be used for the purpose, and (2) the difficulties involved in getting any fungicidal substance to adhere to the fruit so as to provide a protective covering over the whole of its surface. Up to the present, the most promising results have been obtained by immersing the fruit within two hours of picking in an aqueous suspension of a proprietary compound known as Shirlan A.G., but so far this method has failed to give 100 per cent. control. Even if treatment of the fruit in this way were found to be effective, however, there are practical and possibly economic difficulties involved in its use which might render it unacceptable. A line of investigation which has not yet been taken up is that of fumigation. Here again, however, limitation in the choice of fumigants is likely to prove a handicap.

Field Trials with Sulphate of Iron Spray.

Last year, in discussing field trials with sulphate of iron spray for pineapples, it was stated that evidence had accumulated to show that iron deficiency greatly increases susceptibility to wilt. Further evidence in support of this conclusion, some of it of a very striking character, has been obtained during the past twelve months. Five rows of a demonstration plot at Amamoor, which was planted in 1936 on a soil possessing a reaction of between pH 6 and pH 7, have been sprayed with iron sulphate solution at regular monthly intervals throughout the year. A recent inspection of this plot disclosed that wilt has recently developed in several parts of the unsprayed sections of the plot, and while it extends in one place right up to one of the outer sprayed rows, the latter are entirely unaffected. Similar, though somewhat less striking, instances of wilt prevention through the regular application of iron sulphate spray have been noted at Moggill and Manly.

Spraying of pineapple plants with iron sulphate spray is of proved benefit, quite apart from wilt prevention, wherever the mean soil reaction lies above pH 5.4. Under such conditions regular monthly spraying promotes both the rate and vigour of growth and increases production. Wholly or in part, all of the pineapple demonstration plots which are located in the Mary Valley receive regular monthly applications of the spray, and the same applies to the plots located at Moggill and Manly. The results which have been achieved are ample justification for the time and expense which have been involved, but growers in the districts mentioned have, in general, been slow to follow the lead which has been given them.

Black Heart Investigations.

Despite intensive investigation, no completely satisfactory explanation of the causal factors underlying the physiological disorder of pineapple fruits known as black heart has been obtained. As yet, it is not even possible to state, with any degree of certainty, the conditions predisposing to black heart.

As previously reported, the occurrence of black heart is closely connected with the carbohydrate metabolism of the plant, but the actual nature of this connection is still obscure. Considerable experimental work has been carried out on this point. Shading plants for a month before picking the fruit increased the incidence of black heart, but complete defoliation of plants four to six weeks before the fruit matured did not have this effect. The amount of sunlight available to the plant appears to be one of the chief factors conditioning the development of black heart, and it has been generally observed that fruit grown on slopes with a southerly aspect are more often affected than those picked from northerly slopes. Similarly, it has frequently been noted that fruit from the northern side of a double row is less affected with black heart than that from the southern side. There is also some evidence that unduly close planting, by cutting down the illumination of the foliage, may increase the incidence of black heart. Field observations suggest that the immoderate use of sulphate of ammonia during the autumn months predisposes to black heart.

Winter fruit which was stored in a refrigerator at about 50 deg. F. developed a certain amount of black heart, but no severe cases were produced in this way. Removal of the tops from the fruit prior to refrigeration had no apparent effect. Fruit picked in the early stages of ripening was affected to a greater extent than either immature or fully ripe fruit.

As previously reported, black heart very definitely tends to occur in fruit with whitish, opaque flesh rather than in those with translucent flesh. Since a high degree of flesh translucence is desired in canning, the type of fruit which is most subject to black heart is one which is of inferior canning quality because, in addition to poor flesh colour and lack of translucence, it is generally low in sugar. Because of climatic influences, this latter type of fruit occurs to a much greater extent in the winter months than in the summer.

Brown Speck and Marbling Diseases.

The pathological aspects of investigations on brown speck and marbling diseases of pineapple fruits are discussed in the report of the Plant Pathology Section. It has not been possible to establish any correlation between fruit quality and the incidence of the brown speck disease, but in the case of the bacterial disease known as marbling, evidence has been obtained to show that superior quality fruit, *i.e.*, fruit possessing a high degree of translucence coupled with a high sugar content, is less susceptible to the disease than poor quality fruit.

Plant Selection Studies.

Work on pineapple plant selection, at Nambour, in accordance with the programme which was drawn up two years ago, and which was briefly outlined in last year's annual report has been continued. As work of this character

is necessarily slow, involving as it does careful observation of large numbers of plants through several successive generations before any degree of finality can be reached, there is little that can be added at this stage to what has already been reported. During the past year, the number of clonal and mass selection plantings which have been under observation has been extended. The former have been planted chiefly in the grounds of the Nambour office of this Department, while the latter are located on various farms throughout the neighbouring districts. Some of the original clonal plantings fruited during the past summer, and from among these several of the most promising have been re-selected for further propagation.

Since work commenced on pineapple plant selection two years ago, special attention has been given to the question of abnormal or "off" types. The data obtained in the course of this study has recently been collated and forms the subject of an illustrated advisory article now in course of publication. This article should prove of considerable value to growers and to the industry generally.

Papaw Investigations.

A programme of physico-chemical investigations on papaw soils, similar to those being carried out on pineapple soils, was started during May of this year. These studies are being coupled with exploratory fertilizer and mulch trials on papaw plantations located in the Sunnybank and Moggill districts. Prior to commencing this programme, observations were carried out on the incidence of "fruit drop" in papaws, which was prevalent during the past summer, and it was found that this trouble appears to be related to the question of soil moisture availability.

Soils Investigations in the Tara District.

During the year, a brief reconnaissance survey of the soils of the Tara district, on the Darling Downs, in relation to their suitability for the cultivation of winter fodder crops was made. It was found that a marked variation in soil types existed in this area, particularly in respect of their capacity to conserve subsoil moisture. It is considered that the soil types which possess this latter characteristic in the highest degree are those which are most likely to prove suitable for the production of winter fodder crops, since the maintenance of an adequate supply of soil moisture appears to be the limiting factor for crop growth in this area.

Further investigation is required before any specific system of soil management can be laid down for this area, however, since the soils are generally deficient in phosphoric acid and nitrogen and this deficiency appears to become intensified very rapidly when they are brought under cultivation. In this connection it should be pointed out that fodder grown on a soil deficient in phosphoric acid may be of questionable nutritional value.

Acknowledgments.

Officers of the Fruit Branch have been responsible for carrying out the great bulk of the advisory work relating to pineapple culture during the past year. In addition, however, the task of carrying out most of the field work connected with the experimental and demonstrational programme has fallen on these officers, and it is desired to set on record appreciation of the capable and thorough manner in which they have discharged these duties. Thanks are also due to the Director of Fruit Culture for the manner in which he has co-operated in furthering the investigations herein reported, not only by providing the services of field officers but also by his keen personal interest.

Again during 1938-39 liberal donations of fertilizer for use in pineapple experimental work were received from A.C.F. and Shirley's Fertilizers Ltd., Fertilizer Distributors Ltd., Nitrogen Fertilizers Pty. Ltd., Paton Burns Ltd., and the Committee of Direction of Fruit Marketing. All of this fertilizer was used on the demonstration plots and the generosity of the firms making the donations has assisted very materially in carrying out the large scale extension project represented by these plots.

H. K. LEWCOCK,
Senior Research Officer (Plant Physiology Section).

Thomas Gilbert Hope, Acting Government Printer, Brisbane.